



The Future of Natural Gas in Mozambique: Towards a Gas Master Plan

Executive Summary

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The World Bank and
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Submitted by:

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EXECUTIVE SUMMARY

“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

1 DECISION HIERARCHY AND THE GAS MASTER PLAN

This report is an initial effort to develop information to identify and evaluate options for natural gas use in Mozambique. The aim is to provide the foundations for a dynamic Gas Master Plan (GMP) to guide policy development in the gas sector in Mozambique and in this sense should be considered as a stepping stone for further analysis and studies over time to further inform policy.

The study is focused on the natural gas sector and the technical and economic issues related to gas use in the Mozambique economy. While the study also considers socioeconomic, environmental, regulatory, and governance issues in connection with the development of a natural gas sector, these issues are evaluated only to the degree that they matter for natural gas development. These issues are not assessed in detail or with a view to the broader questions they inevitably raise regarding social and economic policy, developmental choices, governance, and equitable and sustainable development in Mozambique. The development of the gas sector will be driven largely by private sector decision-making, based on market and economic imperatives and where the market and financial risks are largely borne by the investors. Mozambique will nevertheless share in these risks to some extent. We view that the GMP and the role of the GoM is to provide a stable, transparent regulatory, fiscal, and financial policy regime to foster development in the gas sector in a way to benefit the country as a whole.

The analysis and recommendations developed in this report are preliminary and the recommended elements of a GMP should be considered as the initial steps that will change as knowledge about markets, supply, and policies evolves. Because the uncertainties about key issues are significant, we identify the need for additional studies and analysis where issues raised involve more in-depth analysis than could be carried out in this study or where the questions are broader than the scope of this gas study.

The Executive Summary generally follows the report outline. We begin with our key recommendations for the GMP and the roadmap for making decisions. Following the decision hierarchy and recommendations, we present a summary of the analysis that underpins these decisions and recommendation, with further details available in the full report.

1.1 CRITICAL DECISION HIERARCHY

The Government of Mozambique (GoM) should make only a limited number of important decisions at present, and recognize that many of the decisions about the gas sector development have to be taken over time in the future as more information becomes available. The state of understanding of gas resources and options for Mozambique are still at a nascent stage, and most of the infrastructure development will take place about 4-5 years from now. There are also uncertainties about the economics of various mega-projects, and the role of gas vs. coal in the Mozambican energy and electricity sectors.

Therefore, ICF recommends the following critical decisions to be made as soon as possible, as these decisions will ensure that the Government will be on track to make other decisions over time:

1. **Expedite the development of the LNG project and exports.** The GoM should complete the negotiations with Anadarko and ENI on offshore development, LNG production, and export as quickly as possible. Options for financing of ENH's equity share in the offshore and LNG development should be considered and resolved. The negotiations will also have to establish price of gas used to establish government revenues—ICF recommends a specific approach as discussed below in the recommendations. This is critical to understanding the economic trade-offs between taking the government's share of gas production in cash or in-kind.
2. **Develop and implement a communication strategy, with transparency being the primary arsenal for combatting misinformation.** GoM must develop and implement a communication strategy aimed at all Mozambican citizenry and other stakeholders, explaining the importance of natural gas (and other natural resource) development and its implications for the Mozambican people. The vision for the gas sector development needs to be communicated broadly —ICF has provided a recommended vision below.

Transparency is the critical weapon in ensuring that Mozambique proceeds along a path towards sustainable and equitable development, rather than a path towards political and social unrest. Transparency and access to, information regarding GoM vision, strategies, decision-making processes, revenue realization and allocation, and development priorities is critical for sustainable gas development in Mozambique and for reassuring investors in this area.

3. **Initiate and follow through on getting more information on a number of studies that are relevant for further decisions.** Options for future studies are discussed in more detail below; the critical studies that need to be initiated soon are:
 - A. Further analysis of existing reserves and options for restructuring exploration leases and licenses for additional exploration for gas development in the central and southern part of Mozambique

- B. Further market analysis (size and depth) to evaluate the potential for, and implications of, specific projects
- C. Focused effort to collect data for the development of a model that describes the relationships between the inputs and outputs of different economic sectors (i.e., an input-output model) for detailed economic analysis of the Mozambican economy
- D. Evaluation of tradeoffs in options for utilizing revenues from the gas sector to maximize the creation of jobs in Mozambique and for investment in infrastructure development
- E. Evaluation of social and economic impacts of specific projects and developmental options and implementation of mitigation options.

1.2 RECOMMENDED TIMING OF FUTURE DECISIONS

Decisions to be made now: early 2013

- Negotiate with Anadarko and ENI to get LNG development in place as soon as possible.
- Work with concessionaires to establish the price of gas going into the LNG plant to be located in Palma upon which to base the value of royalties and the government's share of profit gas from Rovuma. This is critical to understanding economic trade-offs between the cash and in-kind options.

Decisions to be made soon: mid-2013

- Decide on how the government will receive its share of the produced gas, i.e., in what combination of cash and in-kind will the government's share of gas will be taken, and how this combination may change over time.
- Develop --
 - An institutional framework plan for how to use cash payments from LNG projects to support development programs in Mozambique;
 - A plan for process and institutions through which gas taken-in kind will be allocated to competing uses.
- Plans should acknowledge that gas-based mega-projects will be approved incrementally over time to manage uncertainties and balance short and long term objectives.
- Begin assessment of "actual" demand for gas in different regions and mega-projects based on price, cost, and willingness to pay.
- Initiate various recommended follow-up studies.

Later decisions: late 2013

- Take steps to ensure that any decisions on large natural gas infrastructure around Rovuma and mega-projects are informed by increased knowledge about gas resources, studies on mega-

project feasibility, and better information on opportunities for small and medium enterprises (SMEs).

- Take steps to accelerate knowledge about future gas exploration and production beyond Rovuma.
- Give priority to negotiating EPCCs appropriate for CBM exploration and production.
- Plan for increased government revenue (royalties and profits) to develop Cabo Delgado and other areas in Mozambique and ensure that the benefits of gas developments are shared equitably.
- Decide on one or two mega-projects in Palma.
- Make incremental decisions about downstream mega-project development, locations and timing.

Decisions to be made beyond 2013

- Finalize transport tariff framework and domestic gas pricing framework.
- Establish the independent regulator for gas transmission and distribution.
- Implement programs to monitor and enforce compliance with environmental impacts mitigation.
- Revisit the GMP and make adjustments.
- Plan for training programs to ensure that adequate labor force is trained for the gas sector.

1.3 RECOMMENDED VISION STATEMENT

As part of this study, a preliminary vision statement was developed and accepted by the GoM Steering Committee, and presented in the stakeholder workshops in Maputo—see below. The recommendations for the GMP are intended to implement this vision statement. It is our recommendation that the vision statement should be disseminated as part of a broader communication strategy, highlighting how the GoM intends to take actions on realizing the vision.

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.

1.4 RECOMMENDED GAS MASTER PLAN ELEMENTS

Based on ICF's analysis and understanding our limitations and existing uncertainties, ICF has developed a set of recommendations that are grouped in the five areas:

- 1. Rovuma development recommendations about the volumes and revenues from Rovuma finds and future gas production.***
- 2. Mega-projects and the relation to promoting broad based development***
- 3. Gas sector regulatory reforms***
- 4. Socioeconomic and environmental issues associated with development***
- 5. Structures for fiscal management***

In addition, a list of additional studies and research needs are highlighted at the end of these recommendations.

It is important to recognize the limitations of some of these recommendations, since these are based on the current analysis. Some of them may change over time as additional studies and research reveal new insights, and as government moves forward in putting together additional rules and regulations.

1. Rovuma Development Recommendations.

1.1 Take only those decisions now that are critical to progress the development of the gas sector.

LNG export project will provide an anchor¹ to support offshore gas development that will also provide gas for use in Mozambique. As such, the LNG project in Palma should be prioritized and negotiations concluded soon. Nothing in the development of a GMP should hinder the forward movement of negotiations to get this project under way. ICF believes that LNG markets could tighten over time and securing contracts for LNG deliveries from Palma will benefit the GoM and the developers.

1.2. In parallel, focus on undertaking specific studies to obtain additional information and knowledge, such that other less-urgent decisions are taken over time on a more informed basis.

Gas development in Cabo Delgado will be a complex process requiring a lot of decisions, but many of these decisions are not urgent and they need to be taken incrementally over time. These decisions will benefit immensely with additional studies and analyses to ensure that appropriate decisions will be made. Conducting these studies should be the GoM focus.

1.3. Decide on amount of gas GoM wants the international oil companies (IOCs) to produce in order to meet export and domestic requirements.

LNG export contracts will require that sufficient quantities of gas be produced to meet LNG export requirements. If the government share of gas is taken in-kind and used for domestic industries then additional gas must be produced to supply the LNG plant. Hence, the GoM will need to plan and negotiate the combination of government share taken in-kind and in-cash with the developers.

¹ An “anchor” project is a large project that alone provides the economies of scale that can justify the investments in capital intensive gas infrastructure, which is then available to smaller users. Anchor projects include LNG export terminals that justify offshore gas exploration and production in the first place; or large power, GTL, methanol, or fertilizer plants that provide the economic underpinning for pipeline expansions.

1.4. Set the price of gas for purposes of the calculation of the government revenues as the netback value from LNG sales, and not as the cost of production.

Negotiations with producers will determine the price at which the government's share and revenues will be determined. The "netback" price is the value of LNG in the market less the costs of transporting to market and the cost of liquefaction. The GoM will maximize the value of its royalty share and its share of profit gas by basing the calculations on the value of LNG netbacked to Mozambique. The advantage to this approach is that it will lead to a higher value for natural gas royalties than a cost-based alternative and is more transparent and more auditable. The main disadvantage is that it would expose the revenues to fluctuations in market pricing, where most long term LNG contracts are indexed to oil prices.

1.5 Take the government share of gas in a combination of cash and in kind.

Under the EPCC agreements, the government share of gas can be taken in kind and in cash. The government should take some amount of gas in-kind for the development of domestic industries. The amount of gas taken in kind should be geared to the economically viable options for mega-project development and domestic use. However, the volume of gas that will be used domestically is limited initially by the pace of development of infrastructure and mega-projects, whereas the GoM needs revenue sooner for development. Furthermore, the specific combination will change over time, as domestic demand for gas increases and as the country develops.

1.6 Accelerate the GoM's knowledge about the potential volumes, timing, and location of future developments beyond Rovuma.

Having better knowledge of future supply potential can help prevent uneconomic investments in infrastructure today. Also, more knowledge engenders more confidence in future revenues and therefore flexibility in development plans. It is important to ensure that not only large fields, but smaller fields in onshore and offshore basins in Mozambique are explored. This may require a restructuring of future (but not existing) exploration and licensing procedures, as well as reducing the size of exploration blocks allotted.

1.7 Negotiate EPCCs with coal bed methane (CBM) developers to exploit the CBM resources in Tete.

CBM resources are both potentially substantial and strategically located for future development of natural gas infrastructure in Mozambique and the broader region. To develop greater knowledge about CBM and its development potential, GoM will need to refine the model EPCC to reflect the different development patterns of CBM exploration and production.

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

2.1 Establish priorities for mega-project development. Beyond LNG export, which is necessary to finance offshore gas development and to create new supply of gas for domestic use, our recommended priority order is as follows: electric power generation, fertilizer, GTLs, and methanol.

Most of the proposed mega--projects would generate regional exports and displace key imports, particularly, in the case of GTLs, fertilizer and power. Small power plants support rural electrification, larger ones exports and system reliability. Mega-projects also generate large tax revenues. Mega-projects are the also anchors necessary for justifying investment in pipelines and other gas infrastructure to urban areas, whereas small and medium enterprises (SMEs) cannot justify such large investments. Once the infrastructure is put in place, based on mega-project economics, the SMEs will benefit from the availability of gas.

2.2 Use a market-based approach to determine which mega-projects should be approved.

Because a number of mega-projects have already applied to receive natural gas and have indicated a range of gas prices they are willing to pay, it would be preferable to use a market-based approach to decide on gas allocation. For example, proposed developers can be required to bid on the available gas supply to test the seriousness of the requests and to determine which projects should have priority over others.

GoM can combine a market-oriented approach with a policy to develop increased domestic uses of gas. Further design of a market-oriented auction/tender “open season”² process should be a follow-on study. The tender process must be developed in a way to ensure an economic allocation of gas supply, that it is implemented fairly, that it prevents gaming of the system, and that it accomplishes the goals of the allocation process. This process can help in determining how much gas to take in kind and which mega-projects should receive priority.

2.3 Encourage the location of mega-projects where they can serve as strategic anchors to promote economic activity.

GoM could start with one or two mega-projects in Palma, and then evaluate future projects over time. We have recommended a power plant and either a fertilizer or GTL plant. Palma development can be pursued while also encouraging development at other locations.

² Open season refers to a process used often in the United States whereby pipelines considering expansions or new pipelines routes hold invite potential shippers to express their interest in buying capacity on the new facilities during a specified time window – the open season. Pipelines thus are better able to gauge customers’ true level of interest.

Encouraging some mega-projects in other locations can provide additional development opportunities for SMEs and pipeline infrastructure. In particular, places like Pemba, Nacala, Nampula, and Beira have resident labor forces and SMEs that can benefit from access to natural gas if it is available.

2.4 Support businesses capable of supplying goods and services to the gas industry and mega-projects.

The development of the gas industry and the mega-projects will need significant goods and services that should be provided by Mozambique businesses. The extent to which Mozambican businesses are able to realize this opportunity to grow and hire workers will largely determine the employment benefits generated by the gas sector development. Direct employment in gas production, processing, and transportation and in the capital-intensive mega-projects will likely be quite modest. The real employment gains for Mozambicans will come from the business that will provide goods and services to these industries and their employees. Employment generation is a key factor in determining the extent to which the Mozambican population will benefit from the development of the gas industry.

2.5 Conduct a detailed power study to evaluate the need for large combined cycle (greater than 300 MW) gas power plants.

Power generation can play an important role in Mozambique's industrialization, and as such it is critical to conduct an integrated analysis of the power sector not only in Mozambique, but of the entire Southern African Power Pool. The entire energy mix for power generation needs to be evaluated to identify the role of gas-based power in Mozambique for local use and export.

2.6 Consider both pipeline and LNG transportation options to move gas around the country.

For short distance transport, pipelines are more efficient than LNG ships or trucks. Pipelines that are sited appropriately near population centers provide an opportunity for SMEs to develop along the way. For example, pipeline transport between Palma, Pemba, and Nacala could result in the development of a number of industries that are not even on the drawing board today. For longer distances (more than 3000 km), domestic LNG shipping can be considered. For example, gas from Palma can be shipped by LNG ships to Maputo or South African cities at lower cost than a pipeline.

2.7 All Mega-projects should deliver solid tax returns for GoM.

The corporate income tax regime should be of public knowledge, as should be the annual tax revenues collected under such regime. **Transparency in decision-making is an essential requirement.**

2.8 Mega-projects aimed at export markets should not be subsidized.

GoM should avoid providing mega-projects developers with excessive tax breaks and other financial incentives to locate in Mozambique, as it would effectively subsidize export markets.

3. Gas sector regulatory reform³

3.1 Develop legislation and regulations for licensing the construction, operations, and pricing of natural gas transmission (high-pressure) and distribution (low pressure) pipelines on a consistent and transparent basis.

There should be standard, publicly available terms and conditions for licensing developers of pipelines and that define service obligations, operating rules, and pipeline tariffs. These terms should not be subject to contract negotiations. The licensing regime should not involve negotiated concession contracts, but licenses based on publicly available regulations outlining the process and criteria for awarding licenses for transmission and distribution. All operating rules, tariffs, and terms and conditions of service should be publicly available.

3.2. Establish an independent regulator to oversee the licensing, operations, and tariffs of gas transmission and distribution pipelines.

The regulator would have authority over all gas pipeline transmission and distribution systems. In many countries, the gas regulator is also the regulator of electricity services, which we recommend for Mozambique.

3.3. Develop and publish transparent and consistent methodologies for natural gas processing, transmission, and distribution tariffs.

ICF makes no recommendation on the tariff formulas for gas supply, processing, and transportation services, but to suggest that gas commodity prices and transmission/distribution costs should be “unbundled”⁴ and that processing and transmission and distribution tariffs be such that developers are assured of recovering their investment and operating costs and a reasonable return (profit).

³ Readers are referred to the recommendations in “Domestic Natural Gas and Condensate Market Study or Mozambique,” prepared for Ministry of Energy, September 2009, and prepared by IPA, Penspen and KPMG. See chapter 10.

⁴ Unbundling refers to the separation of gas price from the price of transportation and distribution. Users of gas would see the gas price separately from the cost of transporting and distributing it. This principle supports Mozambique’s rules for allowing third party access to pipelines.

3.4. Gas prices should reflect the true cost of gas and should not have any indirect or implicit subsidies.

Gas prices should reflect the true cost of gas and not subsidized prices. It is important that pricing of gas be carefully considered to eliminate any indirect or implicit subsidies.

3.5 Power tariff adjustments should be made to support the expansion of generating capacity and should be treated as a matter of priority for the energy sector as a whole.

When electric power tariffs in any country fall below a level that reflects the true economic costs of supplying power, it not only becomes a financial drain on the utility company responsible, thereby denuding the company of its own resources for investment, but it also diminishes the creditworthiness of the utility and therefore the sector as whole. Power tariff policy should consider increased access to power for Mozambicans, expansion of generation capacity to meet demand, fuel mix of generation, true cost of transmission and distribution, and affordability of electricity to various sections of society.

4. Socioeconomic and environmental issues associated with development

4.1. Improve the business environment to encourage investment in SME gas using industries.

A number of studies have pointed out the difficulties of doing business in Mozambique that appear to retard the development of SMEs. GoM should take steps to reduce the barriers to SME development, promote SME development, and improve ease of doing business. The availability of natural gas by itself will not make SME expansion any more viable. The 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 transformation. The effort should identify key SMEs, their energy uses, equipment requirements, and pricing points.

4.2. Direct some of the government revenues into PPP investments in gas distribution systems to expand small scale use of gas. The major focus should be on providing access for SMEs.

It is likely that private investors will not be in a position to finance a pipeline that will depend on throughput that will grow over time. Pipelines can take more than 10-20 years to become viable. The GoM would be in a better position to share those risks in order to expand the domestic market for natural gas. The ROMPCO pipeline and MGC are been examples of such investment. The principal advantage is to help grow a market for gas and reduce dependence on other imported fuels.

4.3. Allocate a portion of the government revenues from natural gas related projects specifically to those communities directly affected by those projects.

While gas is owned by all Mozambicans, allocating some resources to the communities directly affected by the disruptive nature of building such large energy projects could help address several potential concerns. For example, in communities where investments are perceived to interfere with existing livelihoods, it is often the case that resources can help strengthen those livelihoods as opposed to harm them, or mitigate any potential adverse impacts. Transparency is critical for the appropriate use of such resources.

4.4. Use revenues to strengthen the existing education and labor training programs led by the Ministries of Education and Labor in partnerships with the private sector.

Expanding access to and the improving the quality of general education is a critical requirement if Mozambique is to develop a more prosperous society. Furthermore, the demands of gas sector development require a workforce with vocational skills to work in the sector. While the GoM has a system to support private sector demand-driven training and vocational education through public-private partnerships, more resources and more attention must be given to implement the programs to make the system work in a timely fashion. 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.

4.5 Develop a plan for minimizing adverse impacts of potential human migration flows associated with the construction of natural gas related infrastructure and natural gas related industrial facilities.

This plan should identify and direct project proponents to locate projects in areas where adverse impacts of migration are minimized. Because these locations would tend to be more populous areas, this will also help stimulate the establishment of industrial facilities in areas where potentially associated SMEs are most feasible. Other considerations should include public-private collaboration in labor force training and provision of public services to any incoming populations, as well as information services to dissuade excess flows of population under unrealistic expectations of employment opportunities.

4.6 Strengthen the GoM's capacity to enforce Environmental and Social Management Plans agreed with private investors because of the ESIA process.

ICF suggests a plan be developed to strengthen the capacity of MICOA to specifically coordinate natural gas related projects. The plan should be based on an assessment of past pitfalls in efforts to strengthen MICOA, and consider the possibility of an office at MICOA focused on environmental management of the natural gas sector and that would be given the tools and

resources needed to monitor and enforce agreed upon Environmental and Social Management Plans. Transparency and responsiveness to requests for information and concerns from the civil society organizations are essential to ensure appropriate distance from private sector interests and focus on MICOA's environmental mission.

4.7. *Revise the recently enacted resettlement regulations to comply with international standards.*

Appropriate resettlement procedures can greatly mitigate adverse impacts of projects and support affected communities. The current regulation does not seem to meet international standards and may not provide adequate protection to the communities potentially affected.

5. Structures for fiscal management

5.1. *Develop a macroeconomic policy that addresses the problems of resource curse.*

Investment must be favored over immediate consumption. The quickest way to spread the economic and social benefits from natural gas would be invest in infrastructure, education, and regulatory reforms. The beneficial impacts of gas revenues on Mozambique's economy are also likely to be much greater if they are directed to investment activity (which creates jobs and follow-on multiplier effects) than if these same revenues are simply consumed as part of the state public expenditures. Mozambique needs to assess the kinds of development that will be beneficial for the country in the long term. This is a key issue and the GoM should give priority for a study to develop appropriate policies.

5.2 *Undertake a study to evaluate options for channeling GoM gas revenues to development.*

Options to consider include:

OPTION 1. Channel GoM funds into private banking system to promote local capital markets.

OPTION 2. Finance public-private investment projects in various sectors under Mozambique's new PPP Law.

OPTION 3. Establish a Sovereign Wealth Fund (SWF).

OPTION 4. Establish a National Transformation Bank (NTB) (or a Sovereign Development Fund -- SDF) owned by GoM and other countries/entities.

OPTION 5. Distribute funds directly to citizens.

5.3 *Begin to coordinate the enormous financing demands required by the natural gas sector as well as the coal and other sectors.*

Funding for the whole energy sector (gas, coal, and electricity) should be coordinated and balanced so that the investments do not overwhelm the capital markets. GoM should work closely with IFIs to monitor its cumulative financial liabilities.

1.5 ADDITIONAL STUDIES AND RESEARCH NEEDS

During our current analysis, we have identified several areas where additional studies are necessary to fully develop the GMP.

1. A Mozambique and regional integrated power study including the South African Power Pool is required. 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. South Africa 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.
2. It is anticipated that there is a substantial, but as yet undefined, demand for gas in SMEs across the country. The question is how to develop infrastructure to serve this demand. Sufficient information on SMEs is lacking. We recommend a detailed study of SMEs, products they produce, typical firm size, costs, and energy use by type, location (province and town). A key element of this analysis would be an evaluation of prices that can be afforded by this sector to be competitive.
3. Because Mozambique ranks so low in ease of doing business, and the problems with doing business fall disproportionately on SMEs, Mozambique should undertake a study to determine where the major barriers are to SME formation and growth and how these can be removed.
4. We recommend that there be a detailed independent assessment study on the mega-project proposals submitted to ENH by developers to evaluate their techno-economic feasibility. In addition, a market-based methodology should be developed to prioritize credible proposals and support gas allocation decisions.
5. The GoM should examine the effect of alternative income tax rate and incentive policies on government revenues related to mega-projects. The focus should be on developing an optimal taxing regime that balances the desire to promote development with the need to generate revenues and not give preferences that are not beneficial to the country.
6. Designing an auction or tender process by which mega-projects would bid on gas supply is a highly technical problem. GoM should engage a study on how such a program should be designed and operated so that it would generate correct information for prioritizing mega-projects.

7. Accelerate the work on a national input-output economic model tailored to the Mozambique economy centered in the INE and Ministry of Planning and Development. This would strengthen confidence in the assessments of the impacts and implications of various development scenarios, as well as generate a substantial data base to assist planners.
8. Given the perceived potential for development of tourism in Cabo Delgado and also the perceived threat that the development of natural gas can place on tourism, ICF suggests a study by done to identify how the development of the natural gas industry can help support and foster the development of the tourism industry rather than be detrimental to its growth.
9. ICF suggests a study be done on strategies of governance of natural resource export revenues that have been successfully implemented to counter the potential underlying mechanisms behind the resource curse, as well as their relative merits for Mozambique. This is tied to the recommendations in Structures for Fiscal Management above.
10. Because a key uncertainty in future development is how much gas could be produced in areas closer to the population centers of Mozambique, GoM should evaluate how the model EPCC could and should be modified to support CBM exploration and development and to promote additional exploration in southern and central offshore Mozambique.
11. This report covers generically the kinds of infrastructure investments that would be needed for gas and mega-project development. GoM should begin more detailed in-depth studies of infrastructure needs tied to specific projects or areas where GoM expects projects to locate. Such studies would include inventories of infrastructure, analysis of potential increased need for infrastructure, and estimate the costs of such infrastructure.
12. All of the proposed mega-projects have exposure to world commodity markets and price fluctuations. Therefore, GoM should retain a firm to provide an independent assessment of those markets, to monitor developments in those markets, and advise the GoM of trends and developments that could affect the viability of mega-projects proposed for Mozambique. GoM should have its own independent, informed view of the market place.
13. GoM should establish metrics for monitoring the development of the gas sector and begin collecting data on a regular basis. We suggest the following sets of metrics to meet different development goals.

To measure the success of efforts to extend gas into the broader economy

- Miles of distribution pipeline
- Numbers of gas customers by sector
- Installation of satellite LNG distribution or regasification facilities and capacity
- Numbers of CNG filling stations
- Numbers of CNG or LNG vehicles

To measure employment and labor force participation success:

- Employment -- numbers and rates of employment
- Employment in the Provinces affected by natural gas development
- Employment of Mozambicans by international oil/gas companies
- Employment in service and input providers to the gas sector and Megaprojects – in absolute terms and as a share of the estimated employment generated along the value chain, in and outside of Mozambique (consider using a measure of local content of service and input provision as a proxy)

To measure success in financial and fiscal management

- Real exchange rate MZN/USD or a basket of currencies
- Non-energy export performance, indexed to output levels
- GDP annual growth, de-composed by sectoral contributions
- Social indicators (school enrollment, literacy, purchasing power parity per capita, health indicators)
- Ease of doing business indicators

2 BACKGROUND

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 the northern part of 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 these areas. Other companies, Statoil, Petronas, and Sasol continue to explore. Rio Tinto and Vale are looking into the development of coal bed methane (CBM).

While these gas discoveries are an economic windfall for Mozambique, they present serious challenges to the GoM in the broader political economy, considered by themselves but especially so with the contemporaneous exploitation of huge coal reserves in the Moatize Basin, the growth of coal exports, and supporting transportation and port infrastructure. These challenges include how to encourage development of the resources in a way that brings the greatest benefit to Mozambique.

In the analyses presented in this report and the recommendations for elements of a GMP a number of themes appear that represent on-going issues and debates within Mozambique policy circles. These fall under two broad rubrics. First is the overall need to use natural gas development to reduce poverty. This is manifest in several policy debates: how to use gas-generated revenues; development in undeveloped regions; education and training; and promotion of Small and Medium Enterprises (SMEs). Second is the need to develop a more transparent and responsive process for ensuring these activities

are carried out in a sustainable and environmentally benign way – the principal concerns of civil society as well as the GoM. Below we briefly summarize the recurring themes related to gas development.

- Transparency. This is a euphemism for a broad based concern by many in Mozambique that corruption is so endemic that decisions will be made, deals struck, practices followed that will benefit a few key decision makers to the detriment of broader society. While addressing this issue is outside the scope of this study, the successful implementation of a GMP and the development of a gas-centered industry in Mozambique must be based on transparent and accountable processes.
- Regulatory Clarity in the Energy Sector. While the GoM has legislation and regulations covering natural gas, regulatory responsibilities and authorities are ambiguous and there is an overall lack of clarity. This will have some impact on investment decisions, particularly in downstream natural gas projects.
- Uses of Revenues. The major issue is whether the GoM should take revenues generated from gas development as cash or in kind. In-kind is seen as a clear way to direct gas use into the economy, create value-added industry, and expand economic development. Cash would be available to provide support for development in a number of areas besides natural gas use. Secondary issues involve: how natural gas taken in-kind can be deployed in the economy, at what price, and under what mechanisms and to whom. Decisions on cash use involve whether revenue should be set aside in a sovereign wealth fund or development bank, or used in ongoing government operations.
- Infrastructure needs and coordination. One of the major questions put forth by various GoM participants in the GMP process has been how will the infrastructure necessary for the gas-based development – ports, roads, airports – be deployed in time to meet the needs of the communities that will host the developments. This is a revenue question as well as a not-so-simple logistical question – the “logistics of logistics” as it has been pointed out. In addition to the infrastructure for natural gas, there also is the issue of coordination with electricity planning, and other infrastructure development. A major concern voiced by some commenters is that government investment decisions will be made in isolation – a GMP should be informed by the electric sector plan and other planning efforts of the GoM. In developing recommendations for the GMP the ICF team has tried to incorporate information from a variety of planning documents.
- Education and Training. The lack of an educated workforce is seen as a major inhibitor to the widespread use of Mozambican labor in the gas sector, where most of the jobs require skills and work habits not common in many parts of the country. Ongoing technical training efforts as well as general education will have to be expanded and focused on those jobs that the industry will need.
- Regional Development. This issue plays out in the discussions over where natural gas using mega-projects should be located. Anadarko and ENI’s Rovuma discovery is in Palma, the far northeastern corner of Cabo Delgado, hundreds of kilometers from the towns where potential gas use exists. The largest employment gains would come with development centered closer to major towns. Nevertheless, Cabo Delgado is in dire need of programs to encourage development, being one of the poorest and least developed parts of the country. Balancing these outcomes is essential.

- SME Promotion. Many commenters have expressed interest in using gas to promote SME growth, much in the way that the MGC pipeline has extended gas use into Matola. While gas would be an attractive fuel for SMEs for process heat and feedstock and can stimulate manufacturing that can compete internationally, it alone cannot promote SME growth. Mozambique ranks low on most of the indicators for the ease of doing business, an aspect of the political and governmental systems that fall mostly on and limits SME development.
- Sustainability and Environmental Protection. Lessons learned from Nigeria and other countries are that development cannot take place where it damages the environment and traditional livelihoods in unacceptable ways. A principal policy of the GoM for gas market development has been sustainability and environmental protection. This is doubly important where the offshore developments are proximate to and can affect fishing livelihoods and tourism.
- Government and Private Decision Making. A source of ambiguity in considering the future of natural gas in Mozambique is the fact that many of the critical decisions will be made by business investors, based on the merits of particular deals. The GoM can determine the amount of gas that can be made available and to some extent the price, and tax policies; but in the final analysis whether to invest in mega-projects will depend on outside markets and opportunities in Mozambique. Pipeline investment also will depend on the expected volume of gas for transport which will in turn depend on the firmness of demand for gas by the large end users.
- Timing of Decisions. Because of the uncertainty around future gas production development as well as the natural uncertainty about international LNG and commodity markets, there should be a natural progression and hierarchy of decision making tied to what is known and what will be known in the future as more information becomes available. Not all decisions should be made now.

ICF's study proceeded under the terms of the Scope of Work to develop recommendations for a Gas Master Plan and decision hierarchy. Analysis covered the following areas.

- 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.
 - Prioritize the various industries for relevance to Mozambique.
- 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 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.

3 GAS SUPPLY OUTLOOK

A major uncertainty facing GoM in developing future plans for natural gas is the size and economics of the gas resource base. As the first step towards developing an understanding of the future of natural gas in Mozambique, ICF developed a gas supply outlook. 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. This exploration is happening now, and will continue on for the next several years.

ICF’s assessment of Mozambique’s conventional oil and gas resources for the purposes of modeling and forecasting employed in-house economic models that use a field size distribution for each ICF-designated region, as shown in Exhibit ES - 1, and assumptions about hydrocarbon makeup including percentage of oil fields *versus* gas fields and various hydrocarbon ratios. ICF estimates that in total Mozambique’s discovered resources are at present 128 trillion cubic feet (Tcf), of which 124 Tcf have been found in the Rovuma north area. There is more gas than has been discovered to date. Based on standard estimating practices, Mozambique has an additional 148 Tcf of undiscovered resources – these are resources that can be inferred from what has been discovered. As more wells are drilled the discovered resources will increase. Considering both the discovered and undiscovered resources the total resource base is estimated to be 277 Tcf—see Exhibit ES - 2. This assessment does not include the potential of CBM in the Tete region but does include assessments of the other regions shown in Exhibit ES - 1.

Exhibit ES - 1: Map of ICF Supply Regions

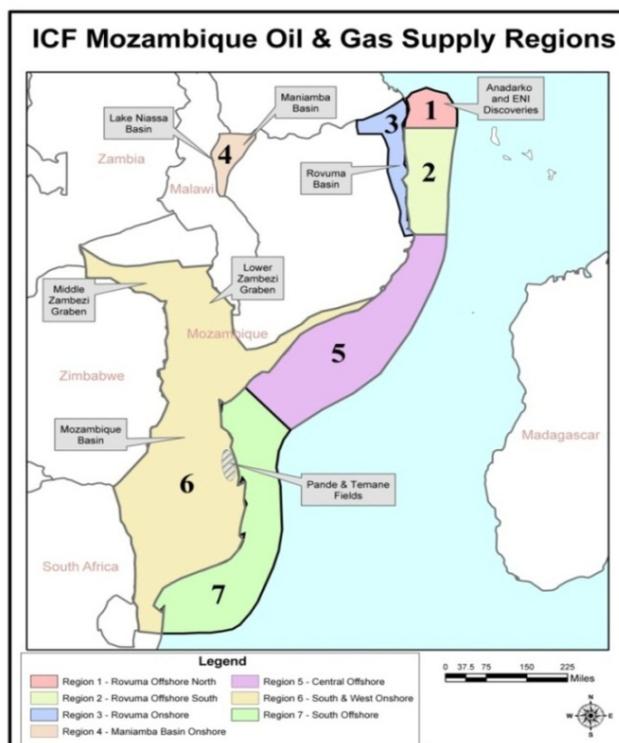


Exhibit ES - 2: Summary of ICF Analysis of Conventional New Field Resources

Region Name	Total Assessed TCFE	3P Discovered TCFE	Undiscovered TCFE
1. Rovuma offshore North	199.4	124.4	75.0
2. Rovuma offshore south	36.0	0	36.0
3. Rovuma onshore	3.1	0	3.1
4. Maniamamba Basin onshore	1.2	0	1.2
5. Central offshore	17.9	0	17.9
6. South and west onshore	5.7	3.5	2.3
7. South offshore	13.1	0	13.1
Total	276.5	127.9	148.1

Source: ICF

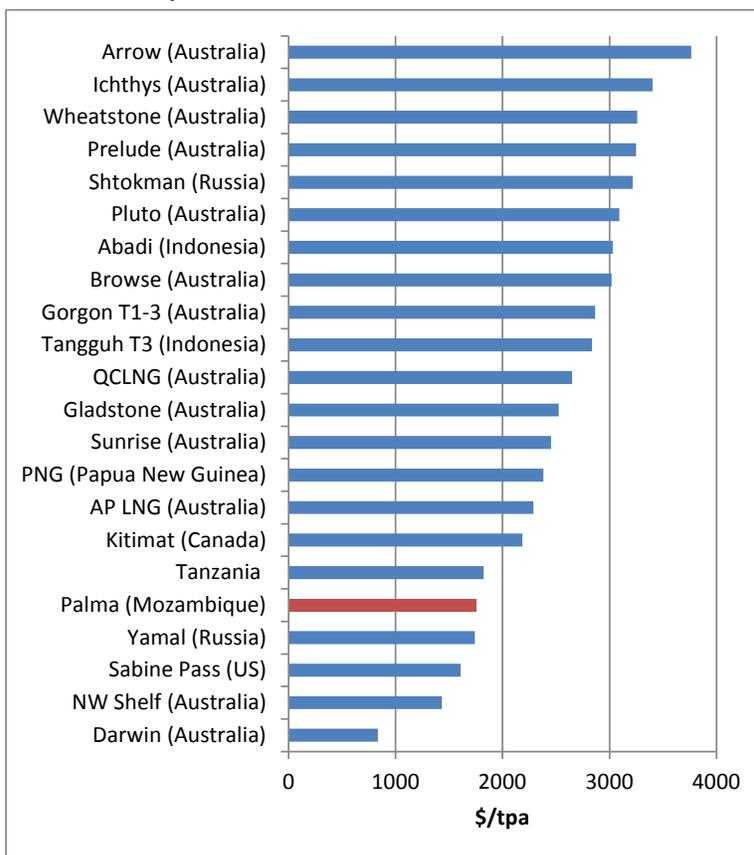
ICF next estimated the cost of producing natural gas by evaluating eight existing fields (for which information was available) using industry standard cost factors and discounted cash flow analysis. These fields include Pande and Temane (combined 3.0 Tcf), which are the only ones producing, and Inhassoro (0.4 Tcf), Prosperidade/Mamba (48 Tcf), Golfinho/Atum (20 Tcf), Coral (5.1 Tcf), Tubaro (1.5 Tcf), and Njika (1.0 Tcf). These fields represent approximately 79 Tcf of 3P reserves. Exhibit ES - 4 shows the results for a 45 year production horizon.

This table shows the resource cost at the wellhead (the cost is expressed in U.S. dollars per barrel of oil equivalent or BOE and in million British thermal units or MMBtu – the common world-wide pricing unit for natural gas) under the terms of the EPCC agreement. Under this agreement, the cost of gas should reflect all of the capital and operating and maintenance (O&M) costs incurred from exploration through production. This establishes the profitability of the gas that is produced from the standpoint of the operators.

The table shows that in the Rovuma Basin (Prosperidade and Mamba), the EPCC wellhead cost of production is about \$1.74/MMBtu where the minimum resource wellhead cost is \$1.18/MMBtu. Adding to this amount an estimate of the costs of gathering pipelines and processing gas for pipeline and LNG, which ICF estimates at about \$0.75/MMBtu, the total costs of gas in Rovuma post processing and ready for delivery into the inlet flange of the LNG facility will be \$2.50/MMBtu (EPCC) or \$1.93/MMBtu (minimum). 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.

The cost of LNG production at Palma places Mozambique in the bottom quartile of potential global LNG projects, indicating a strong position for Mozambican LNG—see Exhibit ES - 3.

Exhibit ES - 3: Capital Costs for Potential LNG Plants across the Globe



Source: Credit Suisse and ICF for Palma LNG; costs includes upstream and liquefaction costs



Exhibit ES - 4: ICF's Production, Reserve and Resource Cost Estimations for Existing Fields⁵

Name	Recoverable Gas (bcf)	Total Exploration & Development Capital Costs (million USD)	Total O&M Costs (million USD)	Total Capital & O&M Costs (million USD)	Production 45 years (million BOE)	Total Costs per BOE of Production (\$/BOE)	EPCC Resource Cost \$/BOE, (\$/MMBtu)
Pande	3,660	350	541	892	740	1.21	2.20 (0.38)
Temane	830	56	67	123	104	1.18	1.47 (0.25)
Inhassoro	400	131	89	220	90	2.45	5.25 (0.91)
Njika	1,000	1,055	496	1,551	181	8.55	33.65 (5.80)
Prosperidade / Mamba	48,000	12,468	9,813	22,281	8,651	2.58	10.07 (1.74)
Golfinho / Atum	20,000	6,600	4,451	11,052	3,605	3.07	12.42 (2.14)
Tubarao	1,500	1,595	538	2,133	271	7.88	38.03 (6.56)
Coral	5,100	3,064	1,412	4,476	919	4.87	22.25 (3.84)

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

⁵ Results are shown in barrels of oil equivalent (BOE) and trillion cubic feet equivalent (TCFE). BOE is useful for understanding the total hydrocarbons in the basins (oil and gas).

3.1 KEY FINDINGS AND CONCLUSIONS

- Mozambique has abundant natural gas resources with a total resource, conservatively estimated, of about 277 Tcf, of which 128 Tcf has been discovered and 149 undiscovered. Much of Mozambique's resource potential has not been evaluated and expectations are that the amount of gas available in other parts of Mozambique's offshore may be substantial. Further exploration and drilling is required.
- Coal bed methane potential was not quantified in this study, but there are indications that the resource is substantial and its location would be of strategic value to Mozambique if developed.
- Mozambique is well situated relative to other potential LNG developments around the world. The ranking of LNG projects considering all capital costs (exploration, production, pipeline, processing, and liquefaction) shows that Palma LNG will be in the bottom quartile of costs.

4 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 ("mega projects") 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. These industries tend to locate near sources of energy (gas). Developers of these kinds of projects, also known as the mega-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, but they by themselves do not usually drive gas

infrastructure development.⁶ Other residential uses such as for cooking or hot water heating, are also opportunistic, and will use gas if it is available, and they have appliances that can use gas, and if it is priced attractively. The liquid petroleum gas (LPG) market concentrated in urban areas is a natural market for natural gas.

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 demand.

4.1 MEGA PROJECT 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 - 5 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 trains. With two exceptions all of the requested projects would be in Palma, near the source of Rovuma gas. However, the requested gas price by the different industries is low, and as such any demand is dependent on the price. Furthermore, these projects are primarily aimed at export markets, and therefore are very much subject to global market forces. Therefore, one should not consider these projects as being feasible at this stage.

Exhibit ES - 5: Industry Requests for Gas Supply, as submitted to ENH

PROJECT	Country	Place of Project	Quantity (MMcf/d)	Quantity (Bcf/year)	Gas Price (\$/MMBtu)	Project Duration (Yrs)
GTL	South Africa	Palma	285	94	5	25
Methanol	Japan	Palma	80	25	4	20
Methanol	India	Palma	130	42	1	30
Methanol	Germany	Palma	1,425	468	2	25
Methanol	Japan	Palma	NA	NA	NA	NA
Methanol	S. Korea	Palma	NA	NA	NA	NA
Fertilizer	Norway	Palma	80	25	1	25
Fertilizer	Japan	Beira	30	11	3	20
Fertilizer	Germany	Palma	90	29	1.5	20
Electricity	Various	Palma	170	554	4	30

⁶ 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.



PROJECT	Country	Place of Project	Quantity (MMcf/d)	Quantity (Bcf/year)	Gas Price (\$/MMBtu)	Project Duration (Yrs)
LPG	South Africa	Palma	NA	0	3.5	20
Pipeline	Mozambique	Mozambique	130	42	2	25
Total			2,410	792		

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 the 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. Therefore, we have not conducted an independent forecast of the demand for the various products; rather we have focused on available public sources of forecast. We have also investigated risk associated with these industries, as related to Mozambique.

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. If the cost of gas in Mozambique is higher than the netback price, it would render a proposed project uneconomic; on the other hand, if the cost of gas is lower than the netback price that would improve their economics. The netback prices for different industrial sectors also can be compared with the netback value from LNG sales and the built up cost of gas based on production and processing costs.

The netback analysis is based on two world commodity price forecasts shown in Exhibit ES - 6. 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). Forecasting commodity prices depends on many assumptions and reality always differs from the forecasts. Therefore, we used a low and a high price cases to determine how robust the netback values are against potential market price fluctuations.

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. The weighted average discount rate was assumed to be 11.5% and the annual capital charge rate was 13%. Details are found in Chapter 5 of the report.

Exhibit ES - 6: Gas and Commodity Price Forecasts (2011\$)

Commodity	Units	2012	2015	2020	2025	2030	2035
High Price Trajectory (IEA WEO 2011)							
Coal, OECD	\$/mt	110	114	119	123	126	131
Crude oil, avg, spot	\$/bbl	96	116	129	139	146	152
LNG, Japanese	\$/MMBtu	13	14	15	15	16	17
Urea	\$/mt	389	458	504	539	567	588
Aluminum	\$/mt	2408	2659	2859	2900	2941	2983
Methanol	\$/mt	492	558	601	635	661	682
Steel	\$/mt	887	727	703	737	773	814
Diesel	\$/bbl	116	141	157	170	180	188
Gasoline	\$/bbl	112	130	142	152	159	164
Cement	\$/kg	0.2	0.2	0.2	0.2	0.2	0.3
Low Price Trajectory (World Bank)							
Coal, Australian	\$/mt	102	75	80	81	83	85
Crude oil, avg, spot	\$/bbl	103	97	88	80	73	67
LNG, Japanese	\$/MMBtu	16	13	12	10	9	7
Urea	\$/mt	419	337	311	275	244	216
Aluminum	\$/mt	2408	2659	2859	2900	2941	2983
Methanol	\$/mt	514	494	463	437	414	392
Steel	\$/mt	887	727	703	737	774	814
Diesel	\$/bbl	136	128	115	104	95	86
Gasoline	\$/bbl	119	113	105	98	91	85
Cement	\$/kg	0.2	0.2	0.2	0.2	0.2	0.3

A summary of the assumptions for the different industrial facilities and the assumptions made for the calculations are shown in Exhibit ES - 7.

Exhibit ES - 7: Summary of the Key Parameters for Industrial Facilities (2011 dollars)

Facility	Product	Output Unit	Size of Typical Facility	Capital Cost of Facility*	O&M Costs	Land Use (Hectares)	Lead Time (years)
LNG Train	LNG	Metric Tonnes	5 million metric tons/year	5,380	82.5	250	5
Power Plant (CT)	Electricity	MWh	150 MW	172	7.4	20	2
Fertilizer	Urea	Metric Tonne	547,500 tonnes/year	782	22.5	20	4
Methanol	Methanol	Metric Tonne	912,500 tonnes/year	1,040	39.2	20	4
GTL	GTL-Diesel, GTL-Gasoline, GTL-Kerosene GTL-Lub Oil	Metric Tonne	50,000 barrels/day	9,680	165.5	250	5



Facility	Product	Output Unit	Size of Typical Facility	Capital Cost of Facility*	O&M Costs	Land Use (Hectares)	Lead Time (years)
Aluminum with Power Plant	Aluminum	Metric Tonne	500,000 tonnes/year	4,018	109.1	263	4
Steel (DR-EAF)	Cold-rolled steel	Metric Tonne	1,000,000 tonnes/year	359	49.5	303	4
Steel (Mini Mill)	Cold-rolled steel	Metric Tonne	300,000 tonnes/year	38	10.5	97	4
Cement	Portland cement	Metric Tonne	1,000,000 tonnes/year	116	8.8	263	4

*Note: Capital cost includes interest during construction.

ICF calculated a levelized cost of the industries 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 (see Exhibit 5-6 in the main report for the detailed criteria) we used for our analysis. The resulting netback values under the low and high commodity forecasts are shown in Exhibit ES - 8.

Under the both the “high price” IEA WEO price stream and “low price” WB price stream, LNG has the highest netback value among the different assets. The power option has the same netback under both price forecasts given that the price of electricity is the same under both scenarios. More efficient power plants (larger plants and combined cycles) will have higher netback prices (as noted earlier). Fertilizer, GTL and methanol all have similar netback values under the IEA price forecasts. However, fertilizer is very sensitive to urea prices, and as such under WB price projections, fertilizer has a very low (close to zero) netback value. Similar to fertilizer, methanol and GTL have high prices under the higher price stream of the IEA WEO, but have fairly low values of about \$1.5-2/MMBtu for the WB prices.

Exhibit ES - 8: Netback Value of Gas in Each Commodity Market

Facility	Consumption (Bcf/year)	IEA Netback Value (\$/MMBtu)	WB Netback Value (\$/MMBtu)	Difference (\$/MMBtu)
LNG	246	9.0	5.0	4
Power Plant (150MW)	9.5	8.8	8.8	N/A
Fertilizer	15.6	6.8	0	6.8
GTL	159	6.8	1.4	5.4
Methanol	18.0	6.9	1.9	5
Steel (DRI-EAF)⁷	11.2	5.3	6.8	-1.5
Aluminum w/ Power Plant	63	3.2	3.2	N/A

⁷ The netback value for steel is higher under the WB price projections because although steel prices are lower under WB price projections, feedstock prices such as coal, coke and iron ore are even lower. As a result, the netback value under WB prices is higher.



It is important to recognize that the gas use in the different sectors is based on the “typical” size of plants in these sectors. There are economies of scale associated with building larger-sized units, and gas consumption can increase enormously if very large plants are built. For example, Gigamethanol has requested gas to build a very large methanol plant consuming more than 450 BCF/year, whereas a typical methanol plant in ICF’s analysis only consumed about 18 BCF/year. The Gigamethanol project would have a capacity of seven million tonnes per year, which is equivalent to 15% of the world’s current capacity. On the other hand, ICF’s assumed plant had an output of about half a million tons. Large plants such as Gigamethanol have lower capital costs per output compared to smaller-sized units, and these large plants will have higher netback values.

Furthermore, Exhibit ES - 8 does not include cement, steel, and aluminum plants, as the consumption of natural gas in these plants are limited and they can be easily replaced by other forms of energy (primarily coal for cement and steel, and hydropower for aluminum) if gas prices increases. Gas use in aluminum manufacturing is limited to power generation (which is reflected in the power plant netback value) and process heating for secondary aluminum production.

Exhibit ES - 9 and Exhibit ES - 10 below show the comparative costs for the different industrial facilities, at the production cost of gas of \$2.6/MMBtu. The profit shown below is the difference between the market price and cost of production plus shipping. It shows that for any MMBtu of gas produced, the profit is highest for LNG. It also shows that larger power plants have higher profits than smaller power plants per unit of electricity sold due to economy of scale and efficiency.

Exhibit ES - 9: Levelized Cost and Profit at Production Cost of Gas at Palma

	LNG	Fertilizer	GTL	Methanol	Power ⁸ (CT) 150 MW	Power ⁹ (CC) 540 MW
Gas Production Costs (\$/MMBtu)	1.70				1.70	
Raw Gas Shipping Costs (\$/MMBtu)	0.07				0.07	
Processing Costs (\$/MMBtu)	0.88				0.88	
Feedstock Costs at Gas Production Cost¹⁰ (\$/ton)	138	87	178	83	\$23/MWh	\$19/MWh
Levelized Capital Cost¹¹ (\$/ton)	160	222	607	262	\$47/MWh	\$49/MWh
Levelized O&M Cost (\$/ton)	18	41	80	71	\$7/MWh	\$4/MWh
Shipping (\$/ton)	82	43	0	59	--	--
Profit (\$/ton)	366	125	273	139	\$43/MWh	\$48/MWh
Market Price¹² (\$/ton)	764	518	1138	614	\$120/MWh	\$120/MWh

⁸ All numbers for electricity are given in \$/MWh

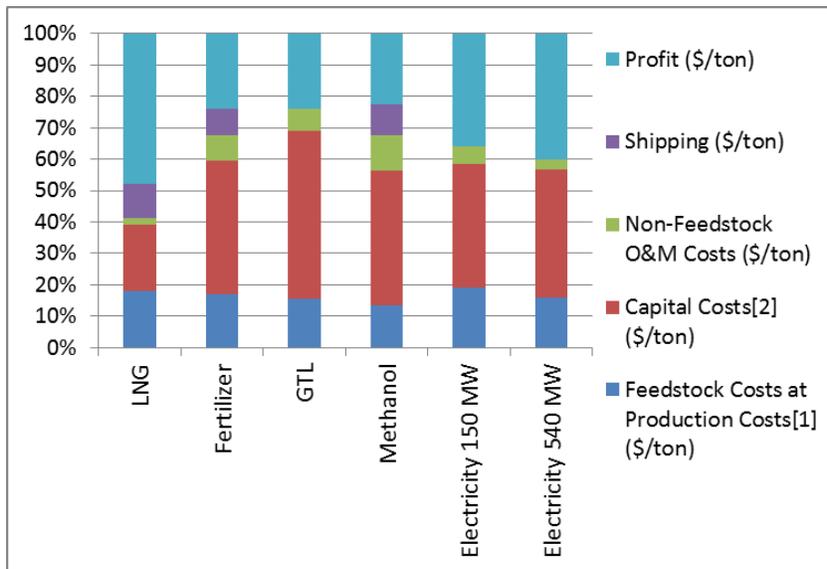
⁹ All numbers for electricity are given in \$/MWh

¹⁰ Natural gas feedstock costs estimated at a total production cost of \$2.6/MMBtu.

¹¹ Includes interest during construction

¹² Average market price between 2012 and 2035 with no shipping costs included.

Exhibit ES - 10: Relative Levelized Cost and Profit at Production Cost of Gas at Palma



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 should 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 for the mega-project developers will be their delivered price of gas. Thus developers would prefer to locate as close to the main source of the gas as possible to reduce the transportation cost to their plants. This means that mega-projects using gas developed in Rovuma will realize a lower netback value if they were to locate farther south because of the additional cost of pipeline transportation. Mozambique will gain from pipeline extensions that provide access to SMEs but the tradeoff is lower product netbacks for the mega-projects that would provide the anchors for the pipelines.

The fairly large disparity in the two price trends and netback analysis should give pause to GoM planners selecting ‘winners’ among the different sectors, as any potential change in market conditions can dramatically alter the ‘priority list’. Exhibit ES - 11 summarizes the current market opportunities and risks for the various sectors. It is, however, critical for the GoM to constantly monitor and update its views on the various markets. Although the GoM should monitor market conditions, the market risks should be mostly borne by project developers, rather than the government itself. Any participation by GoM in projects will expose the GoM to the same risks as the project developers. This also implies that the government needs to evaluate critically the importance of the various products in the local market before considering any kind of subsidies or incentives to specific sectors. Furthermore, the various

sectors should be able to operate on an even playing field, and any variations should be specific and limited in scope and timeframe.

Exhibit ES - 11: Summary of Key Market Opportunities and Risks

Market Sector	Key market opportunities	Key market risks
LNG	<ul style="list-style-type: none"> • Critical for offshore gas development—“anchor industry” • Long term (~20 yr) contracts 	<ul style="list-style-type: none"> • Limited window of opportunity • Competition from other LNG producers in Africa and elsewhere can put a downward pressure on price • Perception that gas being exported and not domestically utilized
GTL	<ul style="list-style-type: none"> • Reduced dependence on refined petroleum products • Potential for regional export of GTL products • Large user of gas—an anchor load for development and pipelines 	<ul style="list-style-type: none"> • High and uncertain capital costs (e.g., Qatar’s Pearl plant) • Reduced oil prices (due to higher supply or lower demand) can reduce value of GTLs • Competition from other South Africa’s GTL plant and other potential producers in Africa
Power Plants	<ul style="list-style-type: none"> • Small-to-medium plants (150 MW or more) can be useful to provide local power in Cabo Delgado and Inhambane • Large CC power plants can be an anchor load for development and pipelines • Gas-based electricity is efficient, with limited environmental problems • Electricity is a key social good and critical for development • High potential for export to SAPP 	<ul style="list-style-type: none"> • Cost of gas-based power is strongly tied to gas price • Power and gas price tariff changes can affect gas power significantly • Transmission constraints in Mozambique limit gas-power development • Competition from other sources (coal, hydro, renewables) needs to be assessed
Methanol	<ul style="list-style-type: none"> • Another pathway for GTL production • Large user of gas—an anchor load for development and pipelines 	<ul style="list-style-type: none"> • Current market is oversupplied, with capacity; low gas prices in North America are inducing previously mothballed capacity there to come online • Prices are linked to global economy, and any economic slowdown in China and rest of the world would reduce prices, as a large amount of demand is in China. • Limited local or regional demand • Project developers have requested fairly low gas prices
Urea	<ul style="list-style-type: none"> • Important for improving agricultural productivity in Mozambique, with agricultural being Reduced dependence on imported fertilizers • Growing local and regional demand • Potential for regional export of urea and other fertilizer products • Large user of gas—an anchor load for development and pipelines 	<ul style="list-style-type: none"> • Uncertain capital costs (e.g., Sumitomo’s Beira feasibility study) • Dependent on global urea prices • Competition from other African fertilizer plants • Fertilizer, by itself, is not a panacea for Mozambican agriculture. Other issues in the agriculture sector have to be resolved.



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 “typical” sized facility (as noted above in Exhibit ES - 7) for each industry except steel and cement where we have determined that the gas use would be very low.

Exhibit ES - 12: Employment by Mega-Project 2012-35

	Fertilizer	GTL	LNG	Methanol	Aluminum w/ Power	Power 150 MW	Power 250 MW
Gas Consumption (MMcfd)	43	402	675	49	172	25	42
Annual Average Direct and Indirect employment	300	2,700	2,300	420	1,300	90	150
Average Long-term Direct and Indirect employment	190	1,600	1,300	320	940	70	120
Average Long term Induced Employment	3,700	31,900	30,100	6,200	18,300	1,500	2,500
Annual Average Direct and Indirect employment per MMcfd gas use	7.0	6.7	3.4	8.6	7.6	3.6	3.6
Long-term direct and indirect employment per MMcfd of gas use	4.5	4.0	1.9	6.5	5.5	2.8	2.9
Long term Induced Employment per MMcfd of gas use	86.7	79.3	44.6	126.2	106.5	59.7	59.7

The estimates presented in Exhibit ES - 12 are based on assumptions regarding the share of mega-project expenditures in Mozambique; the labor productivity in those sectors stimulated by domestic expenditures; and the corporate income tax rate that these projects would pay. 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 magnitude of benefits of different mega-projects:

- The relatively low employment per unit of gas use of LNG reflects the large amount of gas that LNG plants consume; the absolute actual employment is quite large – but it is offset by a larger denominator (the amount of LNG produced).
- The higher values for employment for aluminum when compared to LNG reflect the smaller amount of gas that these plants actually consume – a smaller denominator.
- When direct and indirect job opportunities are considered, the facilities actually differ little in the skill set of the labor force that would be typically demanded (not shown in Exhibit ES - 12): 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).

Based on the netback analysis, market risks, and the economic analysis of different industrial gas uses, ICF has proposed the following prioritization of various sectors.

Exhibit ES - 13: Tentative Priority Order for Gas Using Sectors in Mozambique

Tentative Priority Order	Sector	Reasoning
1	LNG	<ul style="list-style-type: none"> Without LNG, offshore development will not happen. Long term (~20 yr) contracts allows for significant investments to occur. Provides certainty to both GoM and developers.
2	Power Plants	<ul style="list-style-type: none"> Availability of reliable electricity will generate significant opportunities for industrialization and rural electrification. Demand for electricity is rising significantly in Northern Mozambique, where there is very little supply at present. Unlike other goods, Mozambique cannot readily “import” electricity for the Northern provinces. Small-to-medium plants, as well as large combined cycle plants, can be considered. However, more analysis is needed to evaluate the competitiveness of gas against other resources, to assess transmission needs in the context of new gas plants, and understand the true export potential in SAPP.
3	Fertilizer (urea) GTL (FT or Methanol)	<ul style="list-style-type: none"> Fertilizer and GTL plants are next in the order of priority. However, more analysis is necessary to differentiate among them. Existence of domestic demand and import reduction in both sectors Both sectors are highly dependent on market prices, especially for export. For GTL, the two pathways (methanol and Fisher-Tropsch) are not differentiated, as more analysis is necessary to evaluate the advantages/disadvantages of the two pathways. In general, additional analysis is needed to understand capital costs, impact of market price fluctuations, and regional demand in a competitive market for GTL and fertilizer.
5	Methanol for export	<ul style="list-style-type: none"> Export markets for methanol is very much subject to market forces High capital costs and existence of supply overhang in the short term implies that export-oriented methanol production will likely be a lower priority
6	Aluminum	<ul style="list-style-type: none"> The primary energy need for aluminum plants is electricity Gas-based electricity dedicated for aluminum needs to be carefully considered, with a deeper analysis of the Mozal plant.
7	Iron and Steel Cement	<ul style="list-style-type: none"> These sectors consume very little gas, and they are not the primary drivers of gas development in Mozambique (or elsewhere) They will only use gas opportunistically.

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. 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. In particular, the feasibility of export-oriented manufacturing should be investigated. 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.

4.2 KEY FINDINGS AND CONCLUSIONS

- Under both the high and low oil and commodity price forecasts LNG for export has the highest netback value among the mega-projects. Power plants have the next highest netback value, and more efficient power plants (larger plants and combined cycles) will have higher netback prices. Fertilizer, GTL and methanol all have roughly similar netback values and no clear prioritization is discernible from the netback standpoint.
- LNG is the anchor project for offshore development of Mozambique's natural gas resources and must be developed if gas is to be monetized and made available domestically. With significant LNG development, there is a limited time window for GoM to obtain the best terms for developing gas in the Rovuma basin. Mozambican LNG will have to compete with a number of upcoming LNG projects in Africa, Australia, and the United States.
- In general, GoM should not select 'winners' without detailed project and market analysis. The government should also not offer low gas prices or other subsidies to industries, unless there are well defined reasons for subsidies, and the project developers can show that the markets are strong and projects are economical. Therefore, a consistent and careful analysis is necessary for evaluating proposed projects and their requests for subsidies.
- Gas-based infrastructure and industries can create new development corridors in Mozambique.
- It is likely that the retail price of electricity has to increase to support the development of new power plants and transmission. Analysis including the potential of new gas-based plants can help provide most economical solution for the Mozambican power sector.
- Mozambican gas can be attractive for fertilizer production. Key competition would be from the Middle Eastern fertilizer plants. South Africa is the biggest market for fertilizer in Southern Africa,

and Mozambican fertilizer plants will have to compete with other regional plants (including Sasol Nitro). Locating fertilizer plants along existing and future transport corridors (e.g., in Beira) would be useful for regional export.

- GTL plants are relatively new globally and there is a potential for cost overruns, similar to the Pearl plant. GTL plants also carry market risk, as the product prices are linked to oil prices. However, GTL would reduce import dependence in Mozambique.
- Direct use of LNG in power and transportation sectors in Mozambique is possible, but however, this is a longer term option, given the current state of LNG utilization technology and costs. Nonetheless, shipping of gas as LNG along the Mozambican coast is an option (vs. pipeline transport).

5 DEVELOPMENT SCENARIOS

ICF has developed a Mozambique Gas Planning Model (MGPM) that was used to evaluate different development scenarios. The MGPM is a linear programming 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.

Exhibit ES - 14 shows the model structure and 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. 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.

For the purposes of the GMP, ICF developed several different scenarios (along with small variations within them). These scenarios are briefly described in Exhibit ES - 15. The scenario analysis focuses on the “northern development area”, which includes gas finds in the north of the country (Rovuma basin) and the opportunities to use that gas for industrial development in the Northern provinces.

Exhibit ES - 14: MGPM Nodes and Transportation Structure (Map—courtesy of EDM)

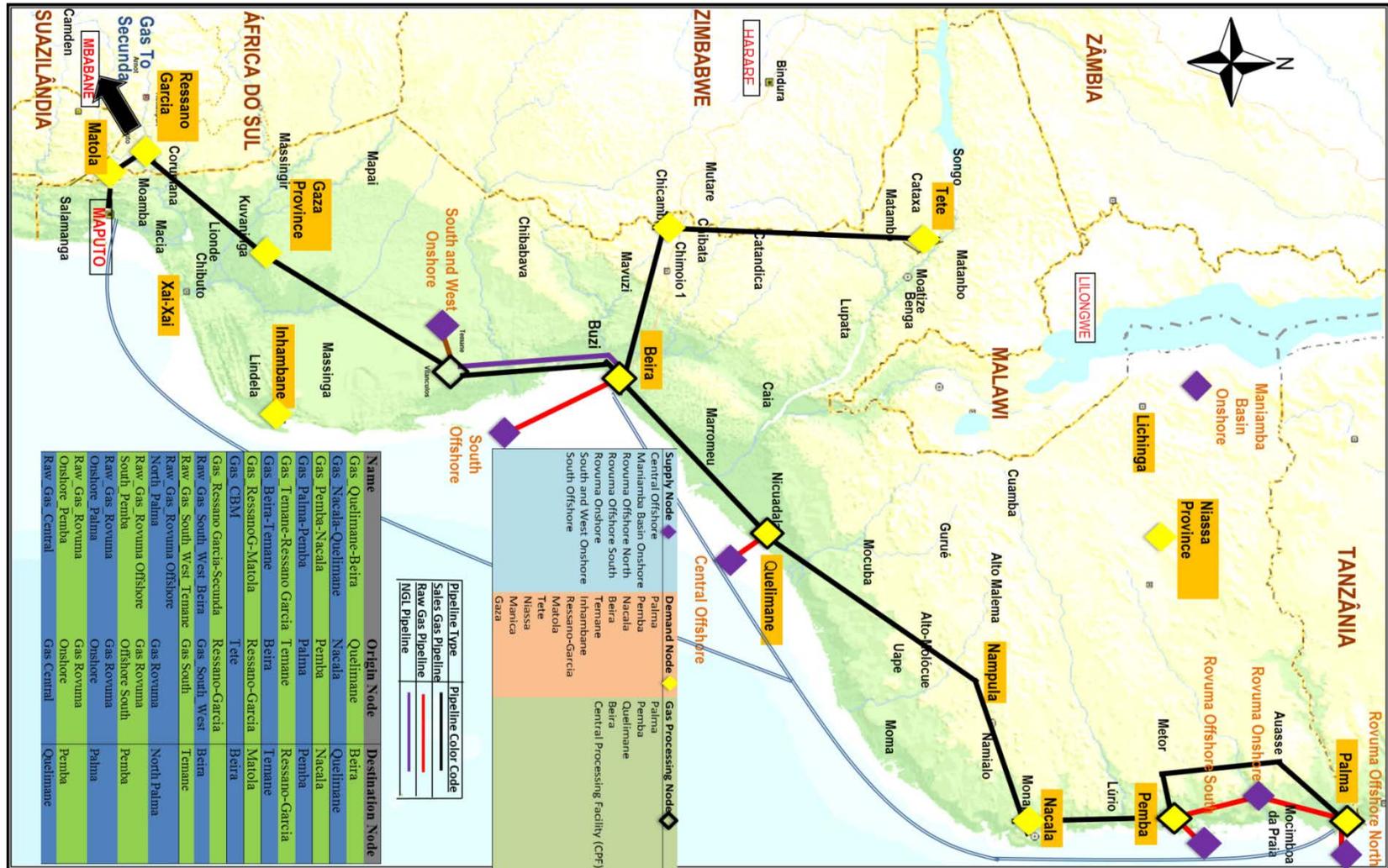
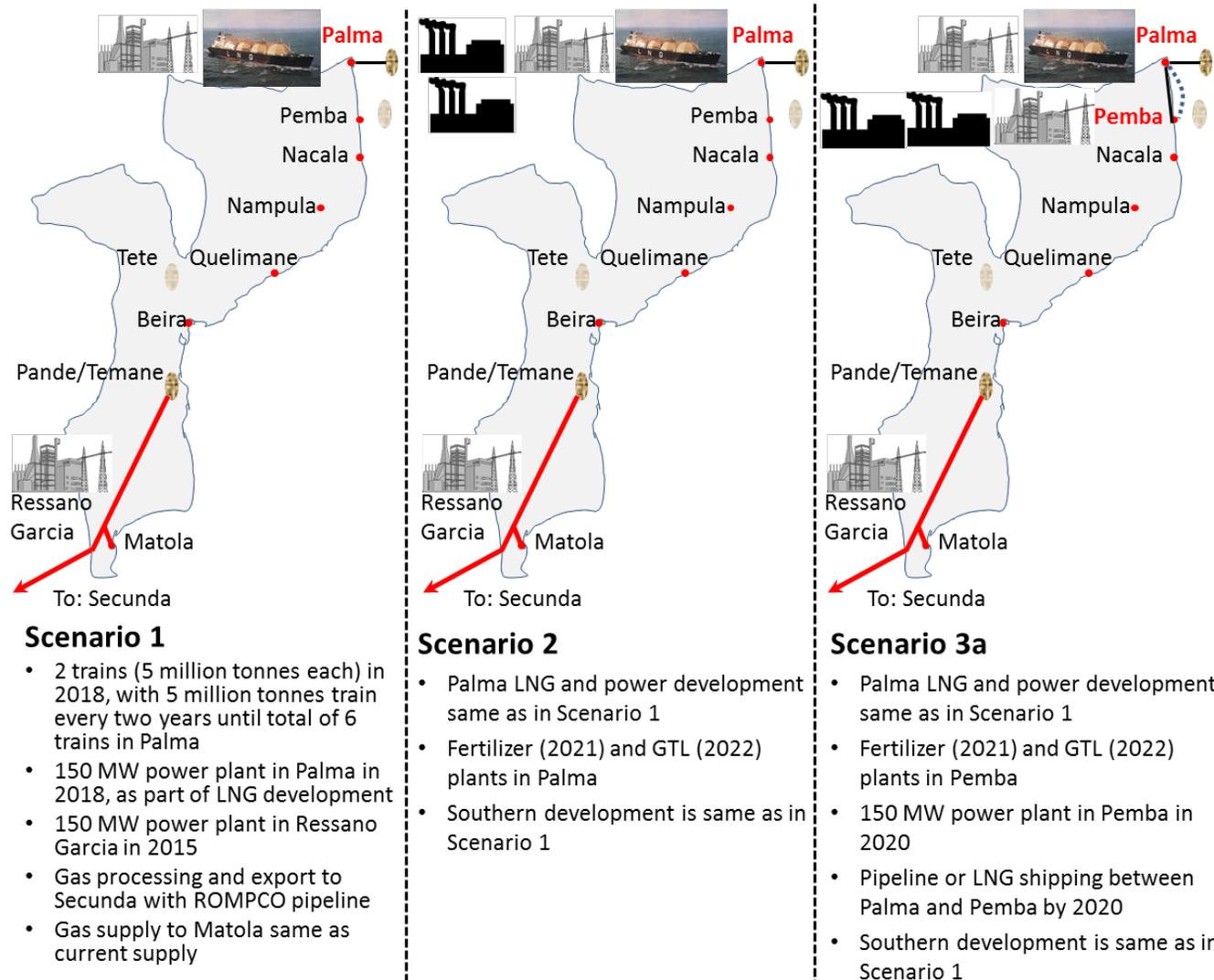
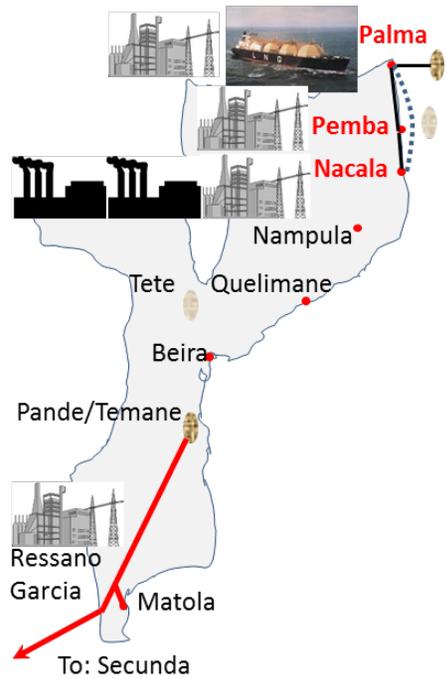


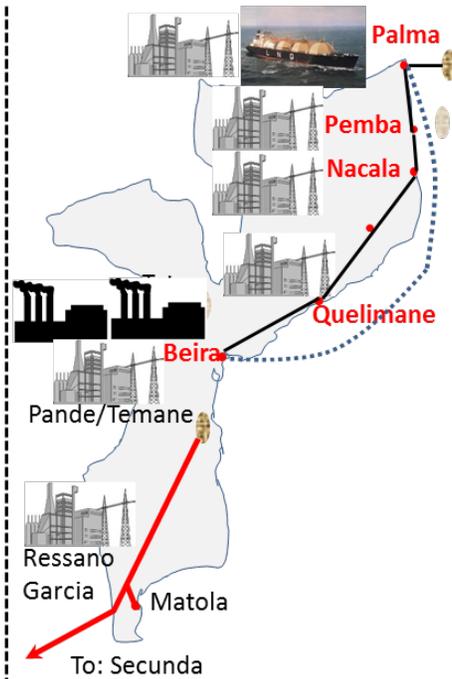
Exhibit ES - 15: Description of Model Cases





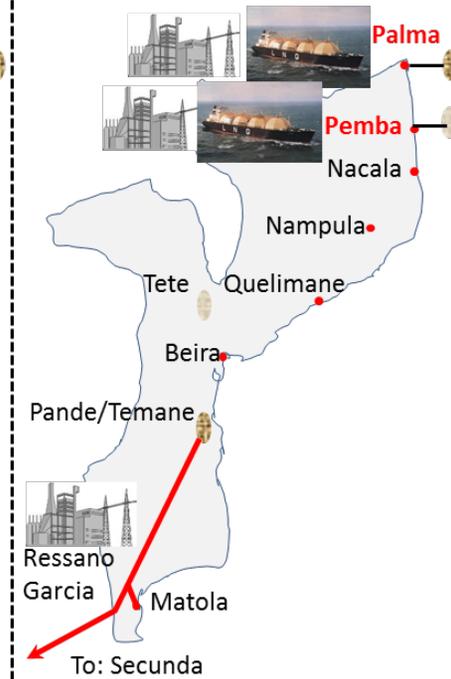
Scenario 3b

- Palma LNG and power development same as in Scenario 1
- Fertilizer (2021) and GTL (2022) plants in Nacala
- 150 MW power plants in Pemba and Nacala in 2020.
- Pipeline or LNG shipping between Palma and Nacala by 2020
- Southern development is same as in Scenario 1



Scenario 3c

- Palma LNG and power development same as in Scenario 1
- Fertilizer (2021) and GTL (2022) plants in Beira
- 150 MW power plants in Pemba, Nacala, Quelimane, and Beira in 2020.
- Pipeline or LNG shipping between Palma and Beira.
- Southern development is same as in Scenario 1



Scenario 4

- Palma LNG and power development same as in Scenario 1
- Offshore development in Rovuma south
- Gas processing and LNG in Pemba
- One 5 million tonnes train in 2022 and second train in 2024 in Pemba
- Southern development is same as in Scenario 1

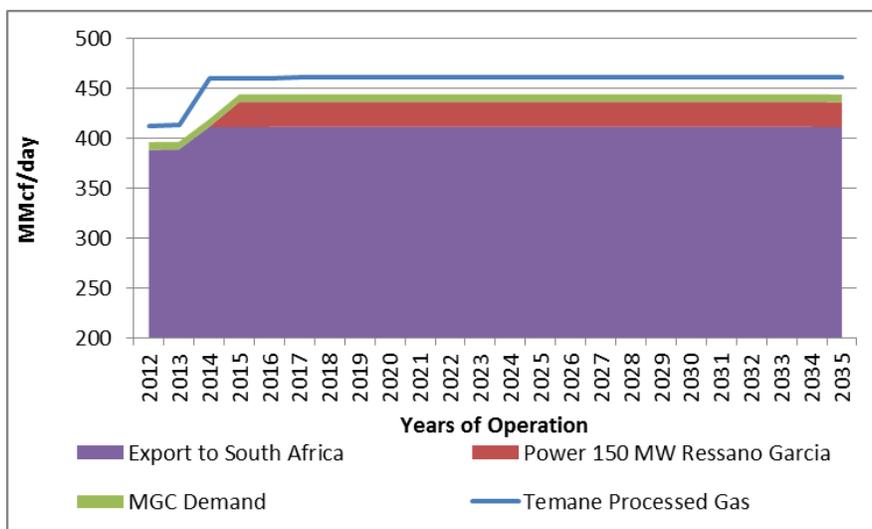
These scenarios are tools that help policy-makers take a “long view in a world of great uncertainty”.¹³ The scenario process provides a context for analyzing the complex set of options available for the development of the gas sector in Mozambique. The “what-if” scenarios described in this section are meant to assess the implications of specific development options. There are a large number of options that can be selected and evaluated. However, ICF only selected a few that we deemed relevant for the GMP analysis. The important point about these scenarios is not that they will actually come to pass, or to select one ‘preferred’ scenario, but that these scenarios will help illuminate the implicit assumptions and mental models that policy makers need to consider—thereby helping to make better strategic decisions that will be sound for all futures.

5.1 DISCUSSION OF SCENARIO RESULTS

Southern Region

As an illustration of the “southern” demand, Exhibit ES - 16 shows the supply and demand balance for the South and West onshore fields (which includes Pande-Temane and surrounding fields, as noted in Chapter 4). This Southern demand is modeled in all of the Scenarios. The demand for MGC is assumed to be 7.6 mmcf/d, and the demand for the 150 MW Ressano Garcia power plant is assumed to consume 25 mmcf/d, starting in 2015. There is sufficient gas in the onshore fields to provide the contracted supply to South Africa, as well as supporting a few other additional developments. Increasing demand for gas in the southern region would require, at some point, reducing exports to South Africa or finding other sources of supply. The difference between the demand and supply in Exhibit ES - 16 is the amount of gas consumed for transportation between Temane and Secunda.

Exhibit ES - 16: Supply and Demand in “Southern” Region of Mozambique (valid for all Scenarios)



¹³ *The Art of the Long View*. Peter Schwartz, Doubleday, New York, 1996.

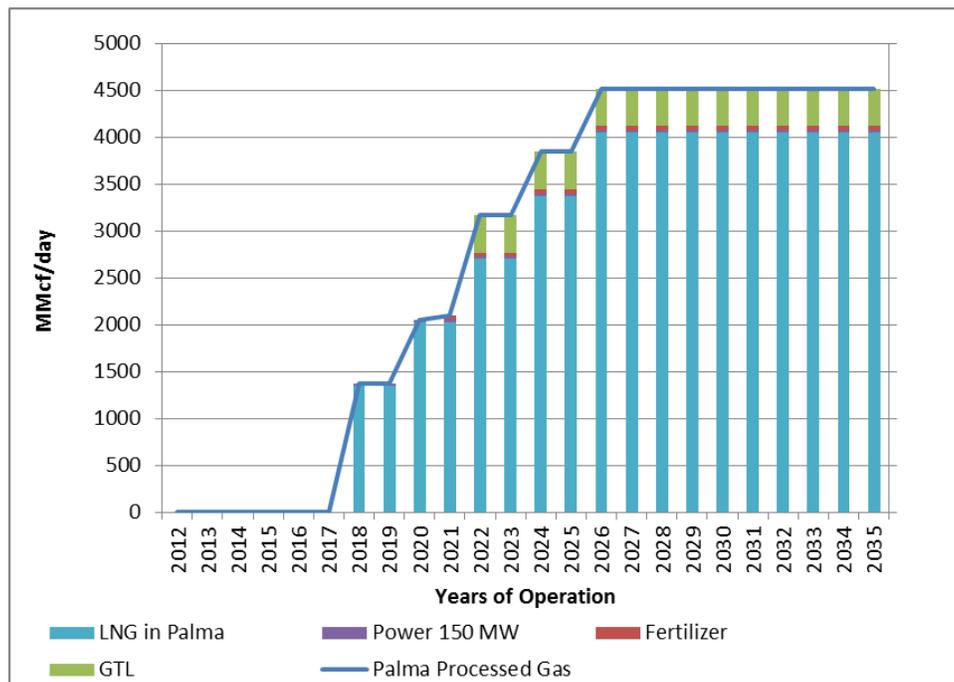
Although the scenarios considered by ICF do not include the possibility of connecting the southern region with the north via pipelines or shipping, this option can be considered in future scenarios. For example, LNG shipping from Palma to Maputo would connect the Northern supply with the Southern demand. Another option would be to connect the pipeline built in Scenario 3c.

Northern Region

Exhibit ES - 17 shows the “Northern” demand of gas for LNG and other industrial facilities, as relevant for Scenarios 1 and 2. In Scenario 1, only the LNG demand is present. In Scenario 2, additional demand for power, GTL, and fertilizer plants are as shown in Exhibit ES - 17. In Scenarios 3a, 3b, 3c, the fertilizer and GTL plants are located in different areas, indicating the gas might be transported to various areas over time. Furthermore, the total volume of processed gas increases to account for the loss of gas necessary for transporting gas over pipelines. The loss of gas due to transport is particularly indicative in Scenario 3c.

It is important to recognize that although ICF considered six trains of LNG in the Palma area, the timeframe for development can be varied, without much significant change in results. For example, the number of trains can be reduced or the time between the trains can be increased, depending on market conditions. At least 10 trains of LNG (5 million tonnes each) can be developed based on ICF’s estimated resources in the Rovuma Offshore North field.

Exhibit ES - 17: Supply and Demand in the “Northern” Region of Mozambique (Scenario 1 and 2)



According to the EPCC, royalty gas and profit gas can be taken by the GoM as cash or in-kind. Therefore, if taken in-kind, a significant amount of gas can be available for industries in Mozambique. There are sufficient gas resources to develop LNG plants and supply gas to domestic industries. ICF relied on the R-factor values shown in Exhibit ES - 18, which are indicative of actual R-factors for Anadarko and ENI in the EPCCs, to determine the amount of profit gas. The volume of profit gas available to the government is dependent on the value of the processed gas. Exhibit ES - 19 shows the amount of profit gas and royalty gas for a two-train 10 million tonnes LNG facility (similar to the expected initial development in Palma) for different assumed prices for processed gas. The gas required for the LNG plant is 1500 mmcf/d, and the plateau for the profit gas is at about 800 mmcf/d. If the price of the gas is higher, then the plateau is reached sooner than later.

Exhibit ES - 18: General EPCC Terms Used for ICF Economic Modeling

Income Tax Provisions	
Development capital max write-off p.a.	25%
Income Tax Rate	32.0%
Production Sharing Terms	
Gas Production Tax (royalty)	2.0% existing fields 6.0% new fields
Cost Recovery Limit (% of Disposable Gas)	67.0%
State Participating Interest	
State Participating Interest (% of all Working Interests)	15.0%
Interest rate for reimbursement (LIBOR+1%)	2.1%

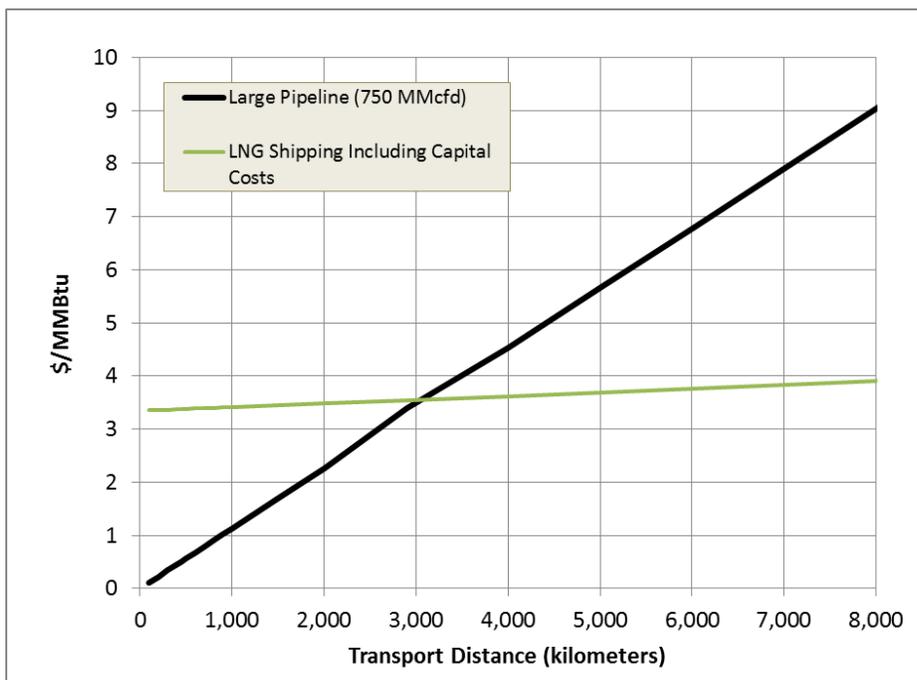
Exhibit ES - 19: Royalty and Profit Gas for a Two-Train 10 million tonne LNG Facility (90% capacity factor)

	Gas for LNG	Royalty gas	Profit gas volume (mmcf/d) at price of		
	(mmcf/d)	(mmcf/d)	\$4/MMBtu	\$8/MMBtu	\$12/MMBtu
2018	1350	27	50	50	85
2020	1350	27	50	205	230
2022	1350	27	95	280	410
2024	1350	27	270	415	540
2026	1350	27	270	545	800
2028	1350	27	395	545	800
2030	1350	27	395	800	800
2032	1350	27	395	800	800
2034	1350	27	395	800	800

If Mozambique were to take profit gas in kind, the LNG contracts would still have to be honored and more gas will have to be produced to supply both profit volumes and LNG sales volumes. This creates additional royalty revenue and profit revenue.

Gas can be transported across Mozambique either through pipelines or LNG shipping. Exhibit ES - 20 shows the pipeline and LNG transportation costs as a function of distance. When transporting gas for short distances, pipeline transport is the less costly option. As the distances get larger, however, the LNG option becomes more attractive. As shown in the exhibit below, the cross-over point where LNG becomes cheaper than pipeline transportation is 3000 km. Therefore, LNG shipping would be more economic for large quantities gas shipped from Palma to Maputo or to South African cities. LNG shipping in Mozambique may have a role, but this role needs to be carefully assessed.

Exhibit ES - 20: Cost of Pipelines and LNG Shipping



A significant amount of infrastructure will have to be developed to realize the LNG plant in Palma and any other industrial facilities that may be developed in the northern part of Mozambique. Currently, the state of development in Palma is quite minimal and large amount of infrastructure development will be necessary. As an initial step, ICF has provided below in Exhibit ES - 21 the kinds of infrastructure that will be needed to construct and support various key facilities. A more detailed study needs to be undertaken to evaluate the full list of infrastructure needed and to develop a plan for developing the required infrastructure.

Exhibit ES - 21: Illustrative List of Required Infrastructure for Gas Development

	Key Elements of Scenarios	Infrastructure Needed
1	Offshore Gas Production	Port facilities for service ships; service ships; equipment warehousing and storage yards; food and consumables storage and preparation; helicopter landing facilities; on-shore worker housing; medical facilities
2	Gas Processing facilities in Palma	Land sites; piping; water sources; roads; equipment warehousing and storage yards; consumables storage; port facilities for receiving overseas equipment and materials; power supply and transmission; sanitation and waste disposal systems; worker housing; food facilities; recreation facilities; medical facilities; airport access
3	LNG liquefaction facilities and export terminal	Land sites; piping; water sources; roads; equipment warehousing and storage yards; consumables storage; port facilities for receiving overseas equipment and materials; power supply and transmission; sanitation and waste disposal systems; worker housing; food facilities; recreation facilities; medical facilities; airport access
4	Power plants	Land sites; piping; water sources; roads; equipment warehousing and storage yards; consumables storage; port facilities for receiving overseas equipment and materials; waste disposal; worker housing; food facilities; recreation facilities
5	GTL (domestic and export)	Land sites; piping; water sources; roads; tankage for storage; equipment warehousing and storage yards; consumables storage; port facilities for receiving overseas equipment and materials and exports; waste disposal; worker housing; food facilities; recreation facilities
6	Fertilizer (domestic and export)	Land sites; piping; water sources; roads; equipment warehousing and storage yards; consumables storage; port facilities for receiving overseas equipment and materials; power supply and transmission; sanitation and waste disposal systems; worker housing; food facilities; recreation facilities; medical facilities; airport access
7	Pipelines for gas	Cleared land right-of-way; access roads; land for compressor stations; power supply and transmission; equipment warehousing and storage yards; pipe storage; SCADA systems for monitoring right-of-way and operations
8	LNG for local coastal transport	Port facilities for local LNG ships and barges; LNG storage tanks; land for regasification facilities; equipment warehousing and storage yards; roads; power supply (plants and transmission)

5.2 ECONOMIC IMPACTS MODELING

ICF developed an economic impacts modeling for the various scenarios described above. Direct impacts are those from the production, processing and commercialization of natural gas. Indirect impacts are those impacts that can be attributed to the development of natural gas, but are not necessarily generated at the same time and location of natural gas production, processing and commercialization.

Exhibit ES - 22 illustrates the ways in which the development of natural gas can generate local jobs and government revenues.

First, production of natural gas offshore and its processing and conversion into LNG will employ labor—both domestic and expatriates. Gas development will result in royalties, profit gas, and taxes to the central government.

Second, expenditures made during construction and operations of facilities and associated infrastructure for the production transport and commercialization of natural gas will also employ labor and generate tax revenues.

Third, to the extent that some of the gas is used domestically, whether by large gas users such as power plants and GTL plants or by smaller industrial and commercial and domestic users, these industrial facilities will also spend resources that support employment generation and generate tax revenues.

Exhibit ES - 22: Direct and Indirect Jobs and Government Revenues from Gas Development

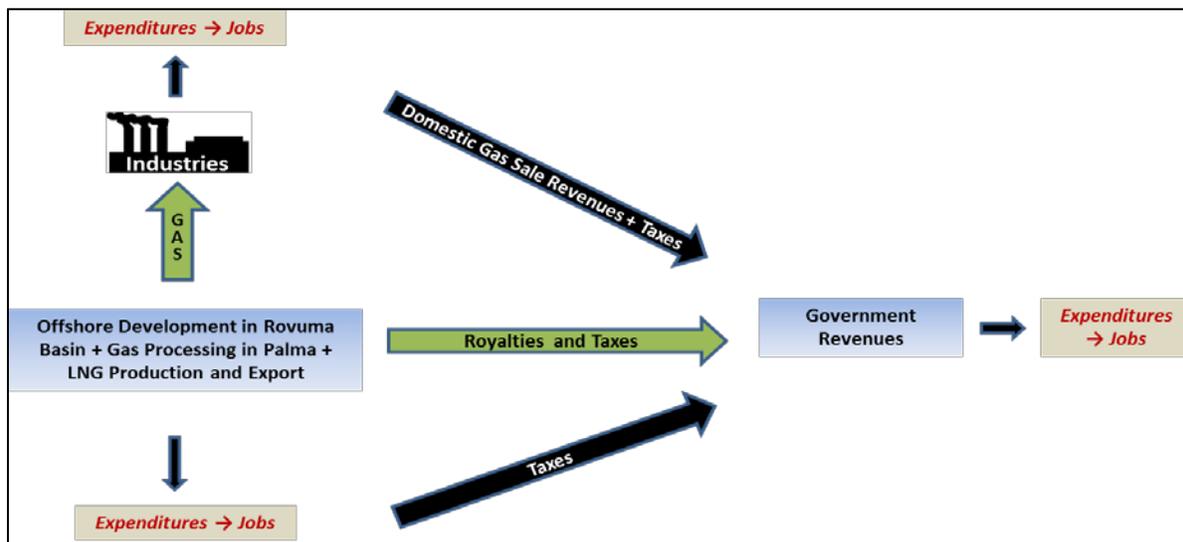
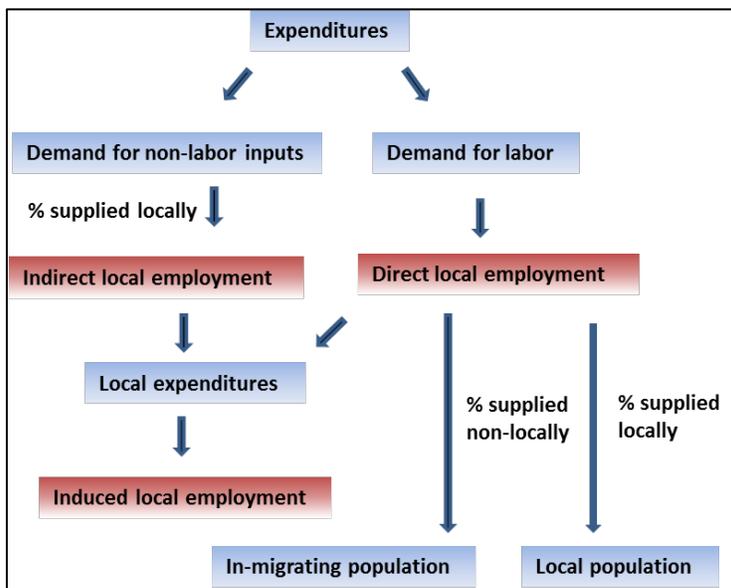


Exhibit ES - 23 illustrates the different ways in which employment can be generated by expenditures made in the local economy:

- by directly hiring labor (**direct employment**);
- by purchasing inputs from providers who, in turn, hire labor (**indirect employment**); or
- by purchases made by direct employees and employees of service providers, which then support employment in those establishments where purchases are made (**induced employment**).

Exhibit ES - 23: Employment Supported by Local Expenditures



Government expenditures also support employment generation to the extent that they are done domestically and in labor intensive sectors. The extent to which taxation favors or not employment generation depends, in part, on the relative labor intensity of those sectors taxed and government expenditures. It also depends on the extent to which government revenues become government expenditures.

Exhibit ES - 22 shows two green arrows indicating the contribution of the gas sector to: a) government revenues in the form of royalties, profit gas, and taxes, and b) other industries in the form of a supply of natural gas. Royalty and profit gas can be received by the Government of Mozambique in cash or in kind, or in any combination. A key question is whether it is beneficial for the government to receive royalties and profit gas in cash, in kind, or in a combination of both.

To address this question, it is first important to understand that LNG producers must fulfill provision commitments with their clients, once these are established. This means that if the GoM chooses to receive royalties and profit gas in kind, the concessionaire will increase its gas production to maintain LNG exports at the level it is committed to with its clients and also provide gas in kind to the GoM—as noted above.

This means that the trade-off between taking gas in cash versus taking gas in kind is relevant only when considering the total life of gas production. The more gas in kind the Government of Mozambique requests, the faster the fields will be depleted. The revenue forfeited in exchange for greater availability of gas in kind for domestic use, is *future* revenue (in cash or in kind). The present value of this future

revenue should be discounted by an appropriate interest rate, when comparing with the present gas-in-kind revenues.

Second, it is possible that some SME industrial uses of gas would be feasible only if the GoM were to sell its royalty and profit gas in Mozambique at a price below what it could receive based on its value as LNG in the world market. Such a fuel subsidy would result in less revenue for the government, but with the potential that the industries receiving the lower priced gas would generate more employment, which is politically more desirable.

Exhibit ES - 24 presents the results of the economic analysis for the different scenarios. This analysis is based in part on an input-output matrix from the United States. Thus, while the results do not fully reflect Mozambique realities, they are indicative of the general level of activity that could be expected. Under all the scenarios, the development of natural gas in Mozambique in the next two to three decades has the potential to more than double Mozambique's current GDP. However, much of the income generated would accrue to foreign capital and would not contribute to the national income.

Exhibit ES - 24: Scenario Model Results

	Scenario 1 Palma LNG and Power	Scenario 2 Palma Development	Scenario 3a Pemba Development	Scenario 3b Nacala Development	Scenario 3c Beira Development	Scenario 4 LNG in Pemba
Average Gas Consumption (Million MMBtu/year) ¹	1,260	1,390	1,400	1,410	2,060	1,630
Average annual Direct labor ²	10,600	12,500	12,700	12,800	18,900	14,200
Average annual Indirect labor ³	3,800	4,400	4,500	4,500	6,700	5,100
Average annual D&I labor ⁴	14,300	16,900	17,200	17,400	25,700	19,300
Peak D&I employment ⁵	33,400	38,500	39,500	40,400	83,400	45,100
Average annual induced labor ⁶	371,500	438,300	444,400	449,800	665,400	544,300
Long-term D&I employment (2030-2035) ⁷	8,900	10,500	10,700	10,800	15,600	11,600
Long-term induced employment (2030-2035) ⁸	211,700	243,000	246,600	249,800	358,800	300,700
Value added (\$billion) ⁹	14.4	16.4	16.4	16.4	21.6	18.7
Total Government revenues (\$billion) ¹⁰	6.26	6.52	6.52	6.52	7.19	7.81
Average annual royalties (\$billion) ¹¹	0.28	0.28	0.28	0.28	0.28	0.36
Average annual profit gas (\$billion) ¹²	4.46	4.46	4.46	4.46	4.46	5.38

Notes: 1. Annual volume of gas consumed in Mozambique by power plants and other industrial facilities under each scenario, including any losses in transport. 2. Labor employed directly during construction and operations of natural gas extraction facilities and processing facilities, transport of

gas and by domestic industrial users under each scenario. Assumes US levels of labor productivity. 3. Labor employed by input and service providers to direct employment generators under each scenario. Assumes US levels of labor productivity. 4. Sum of direct and indirect labor. 5. Direct and indirect labor during year of peak employment (typically a year of intensive construction). 6. Labor employed in the rest of the economy by businesses selling to those directly and indirectly supported by the natural gas industry and industrial facilities under each scenario. Assumes Mozambique levels of non-agricultural labor productivity. 7. Direct and indirect employment under each scenario after construction is over and all assumed facilities are fully operational. 8. Induced employment under each scenario after construction is over and all assumed facilities are fully operational. 9. Value added by natural gas production and processing plus all expenditures done in Mozambique (including payment to Mozambique factors of production such as labor), minus expenditures with imports. 10. Royalties, profit gas, corporate income taxes on gas production and tax revenues from local expenditures (17.6% used as a measure of tax revenues as a share of GDP). 11. Royalties paid to the GoM by gas concessionaires. 12. Profit gas earned by the GoM from natural gas production.

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 between 3% and 6% 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 are an important source of revenue for the Government of Mozambique. Even with the various tax holidays and other allowed reductions in tax rates under current law, we estimate they could be comparable to the total tax revenues currently collected by the Government of Mozambique.

Exhibit ES - 25 summarizes employment generation and value added associated with each scenario, in proportion to the gas energy consumed. As previously explained, differences among scenarios reflect the assumptions regarding the number of gas using facilities in each scenario and to some extent also the losses of gas expected along pipelines (the longer the pipeline, the more loss expected). All of the scenarios have similar results. The slightly lower value-added estimate for Scenario 3c, Beira development, is due to the cost of pipeline transportation to get gas to Beira, which reduces the netback prices mega-project developers can receive by having to transport gas from Rovuma.

Exhibit ES - 25: Summary Scenario Analyses per Million MMBtu/year

	Scenario 1 Palma LNG and Power	Scenario 2 Palma Development	Scenario 3a Pemba Development	Scenario 3b Nacala Development	Scenario 3c Beira Development	Scenario 4 LNG in Pemba
Average annual D&I labor per million MMBtu	9.3	9.9	10.0	10.0	10.4	9.4
Peak D&I employment per million MMBtu	21.7	22.5	23.0	23.3	33.9	21.9
Average annual induced labor per million MMBtu	241.3	256.7	258.3	259.4	270.5	264.4
Value added (\$million)	9.3	9.6	9.6	9.5	8.8	9.1

The qualitative considerations are shown in Exhibit ES - 26. 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 - 26: Scenario Model Results Qualitative

	Scenario 1 Palma LNG and Power	Scenario 2 Palma Development	Scenario 3a Pemba Development	Scenario 3b Nacala Development	Scenario 3c Beira Development	Scenario 4 LNG in Palma
Impact on Local Trade	Low	Medium	Medium	High	High	Low
Support to Growth Pole Strategy	Low	Medium	Medium	High	High	Low
Support to SME Development	Low	Medium	Medium	High	High	Low
Timing	Shortest lead time	Longer lead time	Longer lead time	Longer lead time	Longest Lead Time	Longer lead time
Contribution to Less Developed Regions	Low	Medium	Medium	High	High	Low
Contribution to Employment and Poverty Reduction	Low	Medium	Medium	High	High	Low

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, 3a and 4 with investments concentrated in Cabo Delgado, and scenarios 3b and 3c, 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 areas of Nacala and Beira suggest investments in scenarios 3b and 3c 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 more populated areas of scenarios 3b and 3c.

The main factor determining the benefit of natural gas related investments for poverty reduction is the extent to which they create jobs that are 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.

5.3 KEY FINDINGS AND CONCLUSIONS

- The scenario process provides a context for analyzing the complex set of options available for the development of the gas sector in Mozambique. The “what-if” scenarios ICF developed are meant to assess the implications of specific development options.
- Total average annual value added for the ICF scenarios range from \$14 to \$22 billion per year, dominated by the LNG production, with total government revenue including taxes, royalties, and profit gas is about \$6-\$8 billion per year.
- Large contributions of the gas sector to Mozambican GDP would not necessarily translate into large contributions to national income, unless revenues are transformed into government revenues through taxes, royalties and profit gas.
- LNG production is critical for development of offshore fields in Mozambique, and without LNG exports it is difficult to see how the existing gas resources would attract development.
- Pipeline transport, although expensive for long distances, can induce gas-based industries along the way, and can be a good option for promoting development across Mozambique.

- The direct and indirect labor ranges between 14,000 (Scenario 1) to 26,000 jobs (Scenario 3c) across the scenarios, with peak employment of 33,000 (Scenario 1) to 83,000 (Scenario 3c). The amount of induced jobs is much higher. On a unit gas consumption basis, the annual direct and indirect jobs created is about 10 jobs per million MMBtu, with annual induced jobs being about 250 jobs per million MMBtu.
- Expenditures made locally and in labor intensive sectors are key for employment generation. The benefits of government revenues depend on how effective the investments are and whether corruption is avoided.
- Because of greater demand, infrastructure and trade linkages, the location of megaprojects in urban centers is more likely to foster additional business development and employment generation.

6 ENVIRONMENTAL AND SOCIAL IMPACTS

Environmental and social impacts of construction and operations of facilities and infrastructure associated with the development of natural gas depend largely on the exact location and design of these facilities and infrastructure, as well as on the implementation of industry best practices designed to minimize adverse impacts. The analysis of environmental and social impacts of natural gas development used the analysis of scenarios to illustrate potential impacts. Because locations are still only very broadly identified in the scenarios analyzed (e.g., around Palma, Pemba, Nacala or Beira), the analysis of environmental and social impacts is only possible at a very broad level and further details need to be developed through specific environmental and social impact assessments for proposed projects. This report focuses on highlighting potentially sensitive environmental and social issues that might be associated with each scenario.

Offshore production of gas in the Rovuma basin and an LNG plant around Palma in Cabo Delgado has the potential to adversely affect environmental and social resources in the area. Potential adverse impacts exist associated to drilling operations, placement of coastal and seabed infrastructure, vessel movements, displacement of terrestrial habitats, leakage and spill risks, interference with economic activities such as fishing and tourism, displacement of local residents and attraction of incoming migrant flows. In particular:

- Drilling operations have the potential to impact water quality (and marine fauna) and important ecosystems such as mangroves, sea grass and coral communities.
- Coastal and seabed infrastructure would likely have adverse impacts on important habitats such as sea grass and corals and may adversely affect fish that use these areas for spawning.
- Vessel movement could potentially adversely affect marine mammals such as the dugong.

- The LNG plant will displace terrestrial habitats and could impact sensitive species of flora and fauna, as well as have important air emissions associated with combustion sources, and would generate waste in need of appropriate waste disposal.
- Drilling and construction of coastal and seabed infrastructure can temporarily displace fish, limit fishing and decrease catch by artisanal fisheries.
- Exploration and production can affect the development of tourism in Cabo Delgado through visual impacts and by reducing the appeal of the area as a pristine environment.
- Natural gas leakages can be dangerous due to the flammability of gas clouds and can also release large amounts of greenhouse gases into the atmosphere.
- Any potential liquid spills (such as oil and diesel spills from ships) can have major and long lasting adverse impacts on marine and coastal ecosystems, including human populations and nearby protected areas.

Industrial facilities and infrastructure associated with natural gas development would also impose additional potential impacts. For example, a pipeline built from the Palma LNG plant south, across the Quirimbas National Park and further south, would require long-term maintenance of Rights-of-Way and would impose risks of gas leakages. The longer the length of the pipeline the greater the area affected including greater potential need for resettlement, restrictions on re-vegetation of areas cleared, opening of corridors for movement of fauna and people and risks of leakages affecting sensitive areas. The relative benefits of alternative forms of transportation of natural gas such as LNG shipments to the south of the country would need to be analyzed in further detail. Industrial facilities have the potential to adversely affect the environment through emissions to air and water, leakage of pollutants to the soil, generation of noise and waste. Co-location of power, fertilizer and GTL plants around one city would have potential cumulative impacts.

Management of adverse environmental and social impacts within acceptable levels requires appropriate planning/siting and development and implementation of enforceable environmental management and monitoring systems. The minimization of potential adverse social and environmental impacts requires special attention to the following:

Existing environmental regulations in Mozambique enable MICOA, who is responsible for environmental audits, to verify environmental impacts and compliance with conditions imposed during environmental licensing, and many of the potential impacts can be reduced to low or negligible levels with appropriate mitigation. However, monitoring and enforcement of environmental management plans and environmental regulations in Mozambique are generally weak and a potential obstacle for efforts to minimize or compensate for potential adverse environmental impacts of development of natural gas in Mozambique. Difficulties in enforcing compliance seem to include availability of resources and possibly issues with staff training and effective processes within MICOA and its decentralized offices. ICF suggests an assessment be done of past shortfalls in efforts to strengthen MICOA's capacity to enforce

environmental regulations and environmental management, and a plan for moving forward should be developed around the natural gas sector.

Tourism in Cabo Delgado may be strongly affected by the development of natural gas off its coast. Current tourism development in Cabo Delgado is modest but the potential for growth is very high. The extent to which development of natural gas in Cabo Delgado can be used as an opportunity rather than a threat for the development of tourism in Cabo Delgado, by bringing resources for the development of support services and infrastructure, and possibly for the protection of nearby conservation areas such as the Quirimbas National Park, require further study.

Construction related employment in the order of several thousand workers will likely not be able to be supplied locally for gas development and an adequate supply of labor will likely require migration of workers from other areas, in all scenarios. The migration of workers from other parts of Mozambique or from neighboring countries has the potential to generate pressure on local housing and public resources that are not equipped to deal with these new migrants. There is a high potential for conflict with the local population. Investments that are able to locate in areas with a relatively larger population (e.g., Nacala) will likely be more manageable than those located in relatively smaller populations (e.g., Palma). The GoM should consider the development of a programmatic plan for minimizing adverse impacts associated with potential migration. The plan should consider a range of decisions to be made by each project, from siting, to labor force training, preparation of support services for incoming populations and information services to dissuade excess migration. The plan could then be applied and adapted to the needs of individual projects.

Recent experiences with resettlement to accommodate large natural resource projects have generated some discontent and have led to a new piece of regulation, approved in May 2012, establishing rules and principles guiding resettlement activities resulting from economic activities. This piece of regulation does not yet meet international standards for resettlement (World Bank OP 4.12; IFC PS 5).

Development of natural resources for export has been often associated with the “resource curse.” Explanations for the potential causal relationship vary, but most explanations associate exports of natural resources with the crowding out of other resources that matter for growth, such as manufacturing, education or other pro-growth activities. The mechanism is often associated with increases in prices (particularly costs of labor and other inputs) that result from an in-flow of export revenues and that reduces the real exchange rate and the competitiveness of other sectors (the so called “Dutch disease”). Other mechanisms include increased incentives for rent-seeking and for possible corruption by government officials, rather than pursuit of pro-growth policies. Avoiding the resource curse requires creating a constituency for the productive use of natural gas revenues and transparency in the management of natural gas resources and ICF suggests further study be done of governance mechanisms that may help counter any potential adverse effects of a surge in foreign revenues related to the development of natural gas (and other minerals) in Mozambique.

Beneficial environmental and social impacts may also be associated with the development of the natural gas sector. To the extent that natural gas based power plants follow natural gas exploration and service local residents, they may contribute to the reduction in the use of wood consumption as a source of energy, and associated deforestation. To the extent that domestically available natural gas is used for transportation, it can offer lifecycle greenhouse gas (GHG) benefits over the use of conventional fuels. In addition, natural gas exploration and the development of associated industrial facilities and infrastructure has the potential to generate employment and government revenues, as discussed in the previous section.

6.1 KEY FINDINGS AND CONCLUSIONS

- The assessment of the social and environmental impact of industries needs to be developed further on a case by case basis based on specific projects and their location and design, as would be expected in an ESIA.
- Pipelines, their alignment and length, can have important potential environmental impacts and must be carefully considered against options for transport such as LNG shipping. This too would be expected in and ESIA.
- Enforcement of social and environmental regulations, monitoring construction, and ensuring that mitigation activities are implemented are important to the minimization of adverse social and environmental impacts.
- Tourism and gas development need not be conflicting, but more detailed assessment is necessary.

7 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 with corporate financing. Private sector partners may make use of project financing. ENH (managing the state participation) will urgently need to structure its financing.

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 the 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)¹⁴, which is higher than the average of a number of similar African countries. The World Bank expects 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 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. Nevertheless, significant work remains to be done.

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.

¹⁴ See World Bank CPS 2012-2015 Table 1, page 6.

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 royalty 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 begun developing a regulatory framework under to which to manage the exploitation of its natural gas resources for more than decade. A recent World Bank Study¹⁵ 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 - 27).

While the key legislative elements are in place, there are a number of concerns about the effectiveness of the regulations and their implementation, particularly as regards transparency, environmental compliance, and population displacement. Much of the final obligations imposed on the concessionaires are in the concession contracts which are not public. Companies are required to prepare environmental impact statements that include environmental management plans, but the lack of enforcement of environmental obligations remains troublesome. Of additional concern is the obligation to compensate people for damages and land expropriation. Recently established regulations for such compensation do not fully meet international standards and displacements in Mozambique have caused local discontent in past cases.

Exhibit ES - 27: Key Elements of Successful Petroleum Legal Frameworks

Area	Key Components
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.
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.
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 mortgage-ability; surface fees.
Protection of the	Environmental impact assessment; environmental impact mitigation; social or community

¹⁵ Fiscal Systems for Hydrocarbons Design Issues World Bank Working Paper No 123 2007. Appendix A.

Area	Key Components
Environment	impact; monitoring and reporting; abandonment liability; reclamation; and environment sureties.
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.

One area of concern is with the effectiveness of the existing regulatory framework for the oversight of transmission pipelines and distribution pipelines. The fact that pipelines are treated as concessions, like the exploration and production activities, reduces transparency and predictability that can inhibit the rapid development of future pipelines and their efficient and fair operation. The ICF team endorses in large part the recommendations of the study prepared by IPA, KPMG, and Penspen for the Ministry of Energy in 2009.¹⁶ There is no primary legislation governing the midstream (pipelines) and the downstream sector (gas distribution) as there is for the upstream sector. Responsibility for gas distribution concession awards are split between the Ministry of Energy and the Council of Ministers. There needs to be a more consistent framework for regulating pipelines, under the direction of a single independent regulatory. This should provide for greater transparency in pipeline tariffs, with standard rate-setting methodology presented in public documents, along with operating rules and obligations (including access and balancing).

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 and described in detail in the main report in Chapter 8. While small users have price regulation, large users negotiate prices.

GoM also will have to establish rules for setting pipeline transportation and distribution tariff charges. These charges 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.” The GoM needs to clarify the appropriate entity for regulating natural gas pipelines and distribution. Such regulation should incorporate not only pricing, but quality of service to all shippers equally, and third party access to the pipelines.

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.

¹⁶ See IPA, Penspen and KPMG, Domestic Natural Gas and Condensate Market Study for Mozambique, September 2009 prepared for the Ministry of Energy/DRAP. Chapter 10 is a detailed assessment of the legal and regulatory framework with recommendations.

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 five options for addressing this issue.

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) or a Sovereign Development Fund 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 challenge 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.

OPTION 5. Direct Distribution to Citizens: The GoM could also consider, from the share of those royalty and profit gas revenues being directed to the State Treasury, a portion that could be set aside for direct distribution to citizens as a monthly cash payment. These direct transfers could be on a graduated scale to favor poorer groups. Such transfers have become a method of choice in a number of countries to minimize the so-called "resource curse", and they can have beneficial social impact by bringing immediate tangible income to the population at large. Such transfers would have to be carefully tailored, and accompanied by measures to guard against inflationary impact and decisions would have to be made regarding their taxability. There is a body of research to support the design of this option, and this could be consulted as part of the follow up work, if there was interest within the GoM.

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.

8 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 four 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; how other countries have managed environmental impacts; 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 gas 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 Mozambicans 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.

Environmental Impact Management (Peru and Nigeria)

Peru. Both Peru and Nigeria have had a checkered past in the protection of the environment with the development of extractive industries (mining in Peru, oil in Nigeria). Many of the problems have arisen in the context local, indigenous populations and the extractive industries. In Peru, the oil and gas sector has not been implicated in egregious examples of environmental harm, but various mining accidents and waste-water spills, as well as the multiple LPG pipeline breakages, have brought close scrutiny to the gas industry along with all other extractive sectors. In the past, citing national interest, the central government had been reluctant to impede mineral resource development, which resulted in violent clashes between anti-mining protesters and the police or military. Recent presidential elections have brought to power increasingly pro-indigenous presidents, which has resulted in political power more

closely aligned with the rural population. The country has made significant strides in tightening its regulations and in enforcement, still problems persist.

Nigeria. Most of the public discussion around energy sector's environmental footprint in Nigeria centers around oil spills in the Niger Delta. The Nigerian National Oil Spill Detection and Response Agency (NOSDRA) estimated 2,400 oil spills between 2006 and 2010. The New York Times cited a report which estimated that around 260,000 barrels per year for the past 50 years have been spilled in Nigeria. These spills have led to severe land, air, and water pollution. Years of neglect and strife between the local populations and the central government have yielded a pattern of pipeline sabotage, which is aimed at either outright theft of the crude or petroleum products, or at exercising political pressure on the government or companies operating in the Delta region.

Summary. The major measures of success will be qualitative. These could include the extent to which companies are in compliance with world standard environmental, health, and safety guidelines. Other measures could include complaints filed with the GoM on environmental matters and enforcement actions undertaken by the GoM to require compliance. The quality of life surveys recommended in the socioeconomic section also can include representations of perceived environmental quality. However, these metrics are not likely to be easily quantified, and may only become observable long after projects are already in place and operating.

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 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, and 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.

Potential metrics of performance include the following:

- Real exchange rate MZN/US dollar or a basket of currencies
- Non-energy export performance, indexed to output levels

- GDP year on year growth, de-composed by sectoral contribution, e.g., contributions by labor, physical capital, total factor productivity
- Social indicators (school enrollment, literacy, purchasing power parity per capita, health indicators)
- Ease of doing business indicators

Considering the Potential for Resource Curse

A major concern expressed by the GoM and stakeholders is how can Mozambique avoid the “resource curse” that has characterized so many developing countries?

Resource curse covers a number of pathologies. The economic literature is voluminous and points generally to the observed phenomenon that countries with abundant natural resources tend to grow more slowly than resource poor countries. The pathologies tend to fall into three categories. First, the resource-rich country’s over-dependence on commodity markets, which can be volatile, can lead to a boom-bust cycle of economic activity. Gyration government revenue can affect the ability to fund domestic development programs through the hard times. Second, investments in booming resource development sectors tend to crowd out investments in other parts of the economy. This is referred to as the “Dutch Disease.” Another aspect of the Dutch Disease is the appreciation of the local currency real exchange rate, making domestic exports more expensive in international markets further depressing domestic non-resource industries. Finally, there is the problem of “rent-seeking” by individuals with authority that can interfere with domestic governance, exacerbate corruption, discourage productive investment, and in some cases lead to regional, ethnic, and political conflict.¹⁷

The experience of Botswana is especially instructive with its development of the Financial Assistance Policy (FAP) to promote the development of a private sector, diversified, industrialized economy. The FAP addressed many of the issues faced by Mozambique:

- (a) Lack of access to financial and working capital for small- and medium-scale productive enterprises owned by citizens;
- (b) Lack of industrial experience, with resulting lack of labor and management skills;
- (c) Lack of exposure to FSE and low labor productivity of low skilled, unskilled, labor;
- (d) Small size of the local market, requiring export in order to achieve economies of scale;
- (e) Need for, and high cost of maintaining, expatriate technical and managerial staff for most medium- and large-scale enterprises; and

¹⁷ L. Kinney, “The Natural Resource Curse and Development: The Experiences of Nigeria and Indonesia,”

(f) Strong and often fierce competition from neighboring South Africa to supply the local market.

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 to be managed by 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. Beyond this the GMP should incorporate certain principles necessary to avoid problems experienced in other countries.

- Good governance, transparency, and participation in decision-making by local communities in order to create trust that can lead to better outcomes. Previous approaches of top down decision making and lack of transparency have contributed to the lack of effectiveness in previous programs.
- 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.
- Avoid environmental degradation associated with oil development and ensure a collaborative approach to local concerns about environmental impacts and mitigation.
- Employment programs seem to be fundamental to engaging local populations in development efforts.
- Timely application of funding to support infrastructure development in advance of major developments, in collaboration with the IOCs.

9 FUTURE OF GAS IN MOZAMBIQUE AND ITS UNCERTAINTIES

The decision hierarchy and recommendations presented earlier reflect both the insights from analyses above and our appreciation for the many uncertainties in key aspects of the issues facing Mozambique. Critical uncertainties include:

We do not know when, where and how much 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. 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

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.

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.

We expect that these uncertainties will be reduced over time with new analyses and studies being conducted over time—including the work that will be conducted as part of the World Bank’s MAGTAP project. We present below ICF’s view of a possible, or desirable, end state for natural gas development in Mozambique.

Exhibit ES - 28: Illustrative End-State Vision for Mozambique in 2030



Major gas developments

- Palma LNG and onshore; Pemba/Nacala LNG; Beira LNG; Sofala, M-10 Block to onshore; CBM development in Tete
- Major gas infrastructure: LPG fractionation, Palma and Inhambane; : Palma-Pemba-Nacala-Nampula; Tete-Chimoio-Beira; M-10 onshore
- Fertilizer & power plant in Palma; petrochemicals in Nacala, Beira, GTLs in Palma and Inhambane
- Pipelines support expanded SMEs, some LNG
- City gas distribution Beira, Nacala, Nampula, Matola, Maputo; residential uses grow

GoM collects \$10s billions from gas for development

- Diversified economy. Agricultural modernization. Broad spread electrification
- Infrastructure demand gap (roads, ports, rails, airports, power, internet) addressed
- Expanded industrialization ,SMEs and spinoffs from mega projects
- Growing educated workforce; growth of professional services (engineering, design, accounting, etc.); Mozambican professionals begin to dominate gas and mega-project sectors
- Mozambique becomes major tourist destination: wildlife, beaches, culture