



United Republic of Tanzania

FINAL DRAFT

NATURAL GAS UTILISATION

MASTER PLAN

2016 - 2045

Dar es Salaam

ACKNOWLEDGEMENT

The preparation of the Natural Gas Utilization Master Plan (NGUMP) document has been done under the leadership of the Ministry of Energy and Minerals. In order to ensure quality assurance and achieve optimum output, various stakeholders have been involved in the development of the document. These included the Energy and Water Utility Regulatory Authority (EWURA), Tanzania Petroleum Development Corporation (TPDC), the Ministry of Industry, Trade and Investment (MITI), Ministry of Agriculture Livestock and Fisheries (MALF), the President's Office Planning Commission (POPC), University of Dar es Salaam (UDSM), Sokoine University of Agriculture (SUA), Tanzania Electric Supply Company (TANESCO), and Tanzania Forestry Services Agency (TFSA).

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MEASUREMENTS AND CONVERSION FACTORS

Symbol	Abbreviation	Conversion
bbl	Barrel	1 bbl = 0.15899 cubic metres
BCF	Billion Cubic Feet	1 BCF = 10^9 cubic feet
Boe	Barrel of oil equivalent	1 boe = 5,800 cubic feet
BTU	British Thermal Unit	1 BTU = 1.06 kJ 1kJ = 0.948 BTU
cf	cubic feet	1 cf = 0.02822 cubic metres
kWh	kilowatt hour	1kWh = 1,000 Watt hours
m ³	cubic metre	1 m ³ = 6.289 barrels
mmBTU	million British Thermal Unit	1 mmBTU = 293 kWh
mmscfd	million standard cubic feet per day	1 mmscfd = 28,316.85 cubic metres per day
MW	Megawatt	1 MW = 1,000,000 watts
TCF	Trillion Cubic Feet	1 TCF = 10^{12} cubic feet
TOE/toe	Tonnes of oil equivalent	1 TOE = 39.68 million BTU = 10 million kilocalories
Tonne	Metric tonne	1 MT = 1,000 kilogramme (kg) = 2,204.6 Pounds (lb)

LIST OF ABBREVIATIONS AND ACRONYMS

AGC	Attorney General's Chambers
BCF	Billion Cubic Feet
BoT	Bank of Tanzania
CAPEX	Capital Expenditure
CBOs	Community Based Organizations
CNG	Compressed Natural Gas
CNGV	Compressed Natural Gas Vehicles
CSO	Civil Society Organizations
DME	Di-Methyl Ether
DRI	Direct-Reduction Iron
DSE	Dar es Salaam Stock Exchange
EAC	East Africa Cooperation
ESIA	Environmental and Social Impact Assessment
EWURA	Energy Water Utility Regulatory Authority
GDP	Gross Domestic Product
GIIP	Gas Initially In Place
GTL	Gas to Liquid
HBI	Hot-Briquette Iron
IEEJ	Institute of Energy Economics of Japan
IOCs	International Oil Company's
JICA	Japan International Cooperation Agency
LGA	Local Government Authorities
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MALF	Ministry of Agriculture, Livestock and Fisheries
MDGP	Minimum Domestic Gas Price
MEM	Ministry of Energy and Minerals
MHA	Ministry of Home Affairs
MITI	Ministry of Industry, Trade and Investment
MLHHR	Ministry of Land, Housing and Human Settlements
MNRT	Ministry of Natural Resources and Tourism
MoESTVT	Ministry of Education, Science, Technology and Vocational Training
MoFP	Ministry of Finance and Planning
MoHA	Ministry of Home Affairs
MTG	Methanol to Gasoline
MTO	Methanol to Oil
MTPA	Million Tonnes per Annum
EMA	Environmental Management Act
NEMC	National Environmental Management Council
NGUMP	Natural Gas Utilization Master Plan
NOC	National Oil Company
NSGRP	National Strategy for Growth and Reduction of Poverty
OSHA	Occupational Safety Health Authorities
PMO	Prime Minister's Office
POPC	President's Office, Planning Commission
PSA	Production Sharing Agreement

PSMP	Power System Master Plan
PURA	Petroleum Upstream Regulatory Authority
REA	Rural Energy Agency
SADC	Southern African Development Community
scfd	Standard cubic feet per day
SMEs	Small and Medium Enterprises
SUA	Sokoine University of Agriculture
TANESCO	Tanzania national Electric Supply Company Ltd
TBS	Tanzania Bureau of Standard
TCF	Trillion Cubic Feet
t/d	Tonnes per Day
TDV	Tanzania Development Vision
TFSA	Tanzania Forestry Services Agency
TEITI	Tanzania Extractive Industry Transparency Initiative
TIC	Tanzania Investment Centre
TPDC	Tanzania Petroleum Development Corporation
TPSF	Tanzania Private Sector Foundation
TRA	Tanzania Revenue Authority
t/y	Tonnes per Year
UNEP	United Nations Environment Programme
VETA	Vocational Education and Training Authority
VPO	Vice-President's Office
WMA	Weight and Measures Agency

EXECUTIVE SUMMARY

Natural Gas Utilization Master Plan (NGUMP) is an integral part of the strategy for the implementation of the National Energy Policy, 2015 regarding the utilization of the resources, the improvement of infrastructures and human capital development in Tanzania. The Government envisages coordinated utilization of gas on the basis of NGUMP, and that to the extent possible, detailed technical and economic analysis should guide selection of the best project for implementation that will address mutual interest of the Nation and investors. NGUMP is a strategic document promoting inter-sectoral coordination in the design and implementation of natural gas development activities.

In its approach, NGUMP takes into account the fundamental reality of the country and the energy sector, recognizing that Tanzania is currently a country with inadequate infrastructure and large labour force that is not yet well qualified to fully support gas development. Therefore, the development of the natural gas industry will contribute significantly to the growth of the Gross Domestic Product (GDP) and stimulate balanced economic and social development.

The objectives of NGUMP are therefore:

- a) To identify current and future demand and supply of natural gas for local and foreign markets;
- b) To set framework for development of infrastructure to supply the market;
- c) To set financing strategy for gas utilization projects;
- d) To maximize the multiplier effect of gas in domestic economy (through facilitation of gas to power, methanol, fertilizer, other petrochemicals and establishment of heavy manufacturing industries);
- e) To promote the use of natural gas as alternative fuel to charcoal and wood for domestic use, feedstock for value added products, industrial heating, power generation and in the transport sector
- f) To reduce foreign currency expenditure by replacement of imported liquid fuels;
- g) To promote long term self-sufficiency, security of supply and environmental friendly source of energy;
- h) To promote local content in the natural gas value chain; and
- i) To promote sustainable upstream activities.

Guiding Principles

NGUMP sets out the following principles, which by their nature, are decisive for the harmonious development of the country, to be observed:

- a) Project initiation;
- b) Regulatory Clarity;
- c) Coordination of Infrastructure development;
- d) Education and Training;
- e) Promotion and inclusion of SME's ;
- f) Environmental Sustainability;
- g) Use of Local Resources; and
- h) Encourage sustainable resource supply.

Linkages of Natural Gas with other Strategic Sectors

Natural gas has multiple linkages (backward and forward) with other sectors and sub-sectors of the economy such as forestry, agriculture, transport, education, health, mining, tourism, commerce, manufacturing, and energy. The NGUMP has clearly analyzed the linkage of these sub-sectors in relation to its implementation.

Gas Utilization Options and Demand Forecast

In Tanzania, natural gas has been used as alternative fuel for power plants, industries, hotels, institutions and households. The use of natural gas for power generation and Industries started in 2004 while households and institutions started in 2009. In magnitude of consumption, power generation is the leading consumer followed by industrial utilization and very minor usage in institutions, households and vehicles.

NGUMP proposes the following utilization options and demand estimates

i) Power Generation

Electricity sector is expected to be the leading consumer of natural gas among all domestic users. According to the revised Power System Master Plan (PSMP) 2015, the installed capacity of the gas fired power plants is projected to increase from 711 MW in 2015 to 1,774 MW by 2020. The resulting demand for natural gas under PSMP assumptions is forecasted at 8.8 TCF over a period of 30 years.

ii) Industrial Application as an Alternative Fuel

Gas demand forecast for industrial use as fuel is projected based on the average regional demand. The average regional demand was established in the market study undertaken in 2011 by MEM in 11 regions of Tanzania. The study projected that in 2016, the natural gas demand for light industries will be 0.076 TCF. For the purpose of this plan, it is assumed that the gas demand for light industries will

grow at 3% annually based on similar experiences from Dar es Salaam industrial gas consumption. This makes a total natural gas demand of 3.6 TCF from 2016 to 2045.

iii) Households, Institutions and Transport

Natural gas will be utilized for cooking and cooling in the households. In forecasting households demand for natural gas, an assumption is made that a typical household will demand 35.5 scfd for cooking. According to the 2012 population census report by National Bureau of Statistics (NBS), Tanzania has about 9,000,000 households with the household size at 5 persons. It is assumed that from 2016 – 2045 the population will, on average, be growing at 1.95% per annum. It is further assumed that 10% of households in the country will be supplied with natural gas for cooking by 2045. This makes a total demand of 0.5 TCF for 30 years.

According to the study undertaken in 2011 by MEM in 11 regions of Tanzania Mainland, it is projected that in 2016 natural gas annual demand for institutions will be 3.6 BCF. For the purpose of this plan, it is assumed that the natural gas demand will grow at 2% annually, hence making a total demand of 0.1 TCF between 2016 and 2045.

Available data shows that, out of 700,000 vehicles registered from 2004 to 2014, sixty percent (60%) use petrol as fuel, which are potential candidates for conversion to Compressed Natural Gas Vehicles (CNGV). NGUMP further assumes that 20% of all petrol vehicles will be converted to use natural gas. Number of vehicles will grow at the GDP growth rate, which on average is assumed 6.1%, thus making a total demand of 0.6 TCF for 30 years.

iv) Fertilizer (Ammonia & Urea)

A good estimation of fertilizer demand would depend on the cultivated area eligible for fertilizer application, as in Tanzania some crops do not require fertilizer to grow but are grown on similar arable land. The Ministry of Agriculture estimates that 485,000 tones will be needed in 2015/16. For economic purpose a world class fertilizer plant is recommended which will be capable of producing ammonia 2300t/d and urea 4000t/d (equivalent to 1.3 million t/y) that will satisfy this demand and provide surplus for export markets. For long term planning according to National Report on Sample Census of Agriculture 2012 arable land under maize is 4,086,555 hectares that require 572,118 tons of fertilizer. Another 906,708 hectares for paddy cultivation will require about 90,671 tons. These two major cereals will require a total of 662,789 tons per annum by 2025. Other crops such as tobacco, sugar cane, coffee, tea, round potatoes and beans will require 222,211 tons adding up to 885,000 tons of fertilizer by 2025. The projected natural gas demand for 25 years is 0.7 TCF.

v) Methanol

In Africa, reliable projections show that demand for methanol is increasing and hence, there is potential for developing methanol value chain in Tanzania. This may involve DME, MTO, MTG, and Methanol to other chemical products (e.g. plastics, paints, pharmaceutical and adhesives). Since some of the recommended projects in this masterplan require methanol as raw material including DME and MTG, methanol production will have immediate market in Tanzania. Surplus methanol can also be exported to the international market. It is therefore projected that for a 1MTPA methanol plant with two trains, 1.1 TCF of natural gas will be required for over a period of 23 years.

vi) Di-Methyl Ether (DME)

DME is a relatively new secondary product whose major feedstock is methanol. It is gaining its popularity as fuel for power generation, domestic fuel similar to liquefied petroleum gas (LPG) and additive to diesel fuel. The dimethyl ether market in other countries is emerging from past years and is expected to grow significantly in the future. Tanzania anticipates to produce and commercialize DME for blending it with LPG, so as to reduce its reliance on LPG imports. This will minimize hard cash expenditure on such imports, and also capture potential export market. A stand-alone DME plant of 0.25 MTPA is projected to consume 0.3 TCF over a period of 23 years.

vii) Gas to Liquid (GTL) Project

Potential demand for GTL products is quite promising in Tanzania as the country depends on 100% imports of these products. It is estimated that GTL will consume 1.8 TCF of Natural Gas over a period of 20 years. A GTL plant with three trains each with capacity of 15,000bpd is proposed. Since the profitability of a GTL project depends on high oil prices as well as low gas prices, a thorough feasibility study is required before the investment decision.

viii) MTG

Gasoline is one of the major white petroleum liquid fuels being imported for consumption in Tanzania, mostly by light and mid-sized vehicles. It constitutes almost a quarter of all petroleum products importation as reported by EWURA Annual Report, 2014. Since a high grade gasoline can be produced from natural gas via methanol in a process called Methanol to Gasoline (MTG), this project can serve a considerable amount of foreign expenditure by the Government.

MTG plant of with a nameplate capacity of 0.23 MTPA with an output of 6,350 bpd and 29,000 metric tons per year is proposed to kick-start production in 2023 which will have a potential to displace about 27% of gasoline and 36% of LPG domestic demand in 2023 when it comes into production.

ix) Iron and Steel Complex

Tanzania has abundant Iron Ore with current proven reserve of 300 million tons. The ore is mainly found in Liganga, Ludewa District over 800 Km from Mtwara and Lindi where natural gas has been discovered. Discovery of natural gas creates a potential for Tanzania to implement an iron and steel project. Since iron deposits are located close to coal deposits, it is anticipated that coal will be used for iron & steel industry. However, for flexibility of project implementation, 1.1 TCF of natural gas has been estimated for a period of 23 years.

Export Options

i) Liquefied Natural Gas

According to International Gas Union (IGU) World LNG report 2014, LNG production in the world has grown steadily from 50 MTPA in 1990 to 246 MTPA in 2014 and its demand projection is expected to grow by 7.6% each year to reach 500 MTPA in 2030. Despite expected growth in demand, it is likely that there will be market volatility for LNG worldwide due to current developments in US, Australia and Mozambique. Hence, the market may be very challenging for new upcoming projects like Tanzania. However, Tanzania is strategically located close to the markets where most of the demand growth is expected. Therefore, the expected potential markets for Tanzania LNG could include Japan, China, South Korea and India (Asian).

According to Petroleum Act, 2015, section 148, a land based LNG facility has been decided against floating options. Given the current discoveries and demand forecast for other natural gas uses considered in the Natural Gas Utilization Master Plan, two LNG trains with a capacity of 5 MTPA each are recommended, which will consume 11.1 TCF for 20 Years. This is equivalent to about 29% of the recoverable natural gas which is 38.6 TCF (70% of GIIP). Alternative demand forecast for three and four LNG trains indicates natural gas requirement of 15.8 TCF and 19.5 TCF respectively.

ii) Pipeline Export Option

Regional gas supply pipeline projects shall be considered to connect Tanzania with East Africa Community (EAC), Southern African Development Community (SADC) and other African partner states. For the purpose of this plan, it is assumed that regional export is inevitable subject to detailed feasibility studies to determine the market and capacity of infrastructure required. With the declining oil price globally, it is possible that pipeline export into the regional markets can be a better option to monetize Tanzanian natural gas. Nevertheless, an amount of 400mmscfd, making a total of 3.1 TCF from 2025 to 2045 has been initially dedicated for export.

Table i: Summary of Gas Demand Projection (2016 - 2045)

	DOMESTIC DEMAND										EXPORT DEMAND		TOTAL	
USER	Electricity	Households	Institutions	CNGV	Industries	Petrochemicals					Iron & Steel	LNG	Pipeline	
						Fertilizer/ Ammonia	Methanol	GTL	DME	MTG				
Demand (TCF)	8.8	0.5	0.1	0.6	3.6	0.7	1.1	1.8	0.3	0.4	1.1	11.1	3.1	33.3
TOTAL (TCF)	19.1										14.2		33.3	

Gas Supply and Demand Balance

Plans to develop the discovered reserves are based on the assumption that 70% of the GIIP will be recovered. In this case, taking the GIIP of 55.08TCF as of July 2015, the recoverable reserves are estimated at 38.6 TCF. Plans to develop the discovered reserves include strategy to supply gas to the domestic and export markets.

NGUMP have formulated three different demand scenarios for base and high case as presented in the Table (ii). For both base and high cases, the existing recoverable reserves can suffice the demand for thirty (30) years for two LNG trains scenario each with a capacity of 5 MTPA. , . For three LNG trains scenario, the recoverable reserves can suffice the demand only for base case. On the other hand, the four LNG trains scenario for both cases shows that, if no further discoveries are made, the projected demand cannot be accommodated in parallel with all other projects recommended in the NGUMP..

It is anticipated that development of natural gas fields will increase the availability of more gas to meet domestic demand as well as export market. This will also trigger discovery of new reserves to cater for the increasing demand.

Table ii: Demand Scenario vs Discovered Reserves

	Base Case			High Case		
Scenario	<i>Domestic + 2Trains</i>	<i>Domestic + 3Trains</i>	<i>Domestic + 4Trains</i>	<i>Domestic + 2Trains</i>	<i>Domestic + 3Trains</i>	<i>Domestic + 4Trains</i>
Consumption	TCF	TCF	TCF	TCF	TCF	TCF
2015→35	16.0	18.0	18.9	17.1	19.1	20.0
2015→45	33.3	38.1	41.7	35.4	40.1	43.8
Against 38.6Tcf	86%	99%	108%	92%	104%	114%
R/P - Yrs (2045)	2.64	0.24	(1.59)	1.51	(0.74)	(2.46)

Infrastructure Development

i) Processing Facilities

Investment in the processing facilities will be required as natural gas demand for both local and regional market grows. The existing processing infrastructure has a capacity of 420 mmscfd. The expansion of processing plant will be called upon the demand growth.

ii) Local and Regional Transportation

The tremendous decrease in LNG prices in Asia and Far East, brings the necessity of considering natural gas export through pipeline to cross borders as a foreseen option. Considering that the market for natural gas is scattered throughout the country and beyond, investments into local and regional transmission pipelines are proposed arbitrarily to be done in phases of five years period. The tentative phasing proposed in NGUMP include Phase 1 that will cover the transmission pipeline to run from Dar es Salaam to Mwanza, from Dar es Salaam to Arusha and from Mtwara to Njombe. The Second phase will be construction of a transmission pipeline from Morogoro to Mbeya, while the third phase anticipated to connect Mbeya to Sumbawanga, Tabora to Kigoma, Mwanza to Kagera and Mwanza to Mara regions. There will be consideration of pipeline outlets to the neighboring countries.

Alternatively, in some remote areas where the pipeline investment is uneconomical due to the demand side and the distance to the point of consumption, natural gas can be moved in liquid form (LNG) by tank trucks, railway tank containers and marine vessels to secondary terminal called satellite station, where LNG is re-gasified for supply via piping services.

The implementation of the above infrastructure will depend on the economic viability of the projects. However, in other areas where there are other alternative sources of energy such as coal, preference will be given to the available sources.

Prerequisites for development of domestic projects

i) Pricing for Domestic gas

To ensure sustainability of the natural gas sub-sector, a proper pricing regime that balances the public and investor's interests is required. Natural gas pricing should encourage use for power generation, industries, transportation, cooking, and other domestic uses compared to other alternative fuels used.

Furthermore, pricing regime must encourage further investment in upstream, mid-stream and downstream to satisfy future demand.

ii) Financing Strategies for Projects

The primary projects which include upstream investment will be financed through PSA partners while secondary projects which include midstream and downstream projects will be financed either through Government, Public Private Partnership or purely private funding. Exceptions may be applicable for Mega project such as LNG and other anchor projects that off-take large quantity of gas such as fertilizer and power projects which can apply a combination of purely private financing or public private partnership.

Institutional Framework

Successful implementation of any development policy depends on institutional framework set in place in developing tools for operationalization, enforcement, monitoring and evaluations in order to attain the intended goals. The NGUMP articulates major roles of key institutions directed towards a transformed economy and sustainable growth and development. These institutions includes: President's Office Planning Commission; Vice President's Office Union Affairs and Environment; Ministry of Finance and Planning; Ministry of Energy and Minerals; Ministry of Industry, Trade and Investment; Ministries responsible for Land, Health, Agriculture, Education National Oil Company (NOC), International Oil Companies (IOCs), Petroleum Upstream Regulatory Authority (PURA), Energy and Water Utilities Regulatory Authority (EWURA), Tanzania Private Sector Foundation (TPSF), Development Partners (DPs), together with relevant institutions.

Action Plan

NGUMP has set timelines for the identified main activities that are necessary to realize the objectives of the Master Plan. It identifies government institutions that should lead the process of preparing the relevant decision tools. The action plan spans the whole spectrum of developing the natural gas industry. It prioritizes among others, development of the legal and regulatory framework, verification of supply and demand of natural gas, integration of the subsector in the mainstream economy, involvement of the public in the natural gas economy, capacity building and adequate environmental management of the sub-sector.

Given the profound and rapid changes that are occurring in the economy, NGUMP should not be seen as a static tool but as a dynamic document that should be yearly updated to reflect the changing reality. A compressive review should be done to coincide with the Five Year Development Plan Strategy.

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FOREWORD

Tanzania has been exploring for oil and gas for more than half a century. From 2010, Tanzania has witnessed increase in exploration activities, resulting in discoveries of significant quantities of natural gas from offshore. Natural gas resource found in Tanzania belongs to the people of the United Republic of Tanzania, and must be managed in a way that benefits the entire Tanzanian society.

These discoveries have created more challenges to the Government and the Tanzania Petroleum Development Corporation (TPDC) on how to manage the fast growing natural gas industry. The challenges include Policy, legal and institutional frameworks to manage the industry more effectively; human resources with the requisite skills and knowledge in the industry; development of natural gas infrastructure; development of domestic market and managing export market; revenue management; high public expectations; and health, safety and environment protection.

Natural Gas Utilization Master Plan (NGUMP), therefore, is an evolving; short, mid and long-term planning document very useful in natural gas industry. It establishes the framework and key elements in the natural gas industry reflecting a clear vision created and adopted in an open process. It synthesizes civic goals and the public's aspirations for some projects, providing procedures and organization, and defines a realistic plan for implementation. It is anticipated that the natural gas distribution infrastructure will be extended to most part of Tanzanian to supply clean energy to Tanzanians and support industrialization strategy of the country.

This NGUMP covers the period from 2016 to 2045 and has four key components. First, it describes the large-scale organization of the natural gas industry and the design principles that will shape the natural gas subsector growth. It distills contributions from many public consultations and recommendation of experts. Second, it identifies funding sources and strategies needed to build the projects. Third, it describes a development schedule, which projects will be built first, which later, which decisions should be made early, which should be allowed to evolve in response to future opportunities and the desires of users. Fourth, it establishes guidelines for the many designers who will draw up specific plans for natural gas utilization projects.

The Ministry of Energy and Minerals (MEM) through a team of experts reviewed several studies made by experts from Trinidad and Tobago and JICA in developing NGUMP for the United Republic of Tanzania. We wish to thank them all. We are also grateful to the suggestions and support received. We finally thank all the people and institutions in Tanzania, too innumerable to list, that the team of

experts had an opportunity to meet with and discuss their views on the natural gas master plan exercise.

The objective was to develop strategies for maximizing the value to Tanzania of recent large discoveries of natural gas, where the Gas Initially in Place (GIIP), as of December 2015, is estimated at 55.08 TCF. The team met several government and other officials, to develop a forecast of the development potential for natural gas and the infrastructure requirements for development and use in Tanzania. The team also analysed market opportunities for Natural Gas in domestic markets (in power generation, fertilizer, methanol production), in the world market (as Liquefied Natural Gas), and predicts regional markets in SADC and EAC blocks.

In order to complete the Natural Gas Utilization Master Plan, the team: examined the relevant labour, social and environmental issues; evaluated financing options and structures, fiscal regime, and regulatory framework; and developed a planning model, which considers the multiplier effects in Tanzania. Let me take this opportunity to extend my sincere appreciation to all stakeholders who participated in the preparation of NGUMP. I also take this opportunity to reiterate the Government's commitment towards continued improvement of the enabling environment for natural gas business. To maximize the benefits accrued from the natural gas resource; the implementation of NGUMP will contribute significantly towards the acceleration of growth and socio-economic transformation of Tanzania in accordance with Tanzania Development Vision 2025, to become a middle-income country by 2025.

Hon. Prof. Sospeter M. Muhongo (MP)
MINISTER FOR ENERGY AND MINERALS

CHAPTER 1. INTRODUCTION

Activities in petroleum sub-sector in Tanzania gained momentum after significant discoveries of natural gas in deep sea around 2010. These discoveries compelled Tanzania to start formulating and setting up the institutional and legal framework to guide the development and proper management of natural gas resource such as the National Energy Policy, 2015, embracing other sub-sector policies (Natural Gas Policy, 2013; Petroleum Policy, 2015; Local Content and Participation Policy for the Oil and Gas Industry in Tanzania, 2015); Oil and Gas Revenue Management Policy, 2015; Petroleum Act, 2015 and the Oil and Gas Revenue Management Act, 2015.

Natural Gas Utilization Master Plan (NGUMP) is an integral part of the strategy for the implementation of the Natural Gas Policy, 2013 that has now been embedded into the National Energy Policy, 2015 (NEP 2015) and other related policies regarding the utilization of the resources, the improvement of infrastructures and human capital development in Tanzania. Therefore, NGUMP is an instrument to promote sustainable development of the natural gas sub-sector. The Government envisages coordinated utilization of gas on the basis of NGUMP, and that, detailed technical and economic analysis should guide selection of the best project for implementation that will address mutual interest of the Nation and investors. NGUMP is a strategic document promoting inter-sectoral coordination in the design and implementation of natural gas development activities. It provides priorities for the utilization of natural gas within the primary objective of directing the resource into domestic use.

In its approach, NGUMP takes into account the facts that Tanzania is currently a country with inadequate infrastructure and large labour force that is not well skilled to support natural gas development. Therefore, this master plan has set a framework for development of infrastructure and comprehensive human resource capacity building to fill the identified gaps to ensure effective development of the natural gas industry.

1.1 Background of the Master Plan

Based on the Tanzania Development Vision 2025 (TDV 2025); Second National Strategy for Growth and Reduction of Poverty 2010/11 - 2014/15 (NSGRP/MKUKUTA II); Five Year Development Plan (2011/12 - 2015/16); National Energy Policy, 2003; and other sectoral and cross-sectoral policies, the Government formulated the National Natural Gas Policy, 2013. The policy provides guidance for development and utilization of the natural gas resources to maximize benefits and transform Tanzania's economy to improve standard of living of her people. This policy recognizes natural gas as a resource

belonging to the people of Tanzania that must be effectively and efficiently managed to benefit the present and future generations of Tanzania.

Realization of the policy objectives requires the promotion of rapid, sustainable, inclusive and comprehensive socio-economic growth, through rural development; provision of basic social services; development of infrastructure; creation of employment opportunities; creation of favorable environment for private investment; development of the national businesses; and support for all economic sectors including the areas of agriculture, manufacturing and processing.

Considering the significance of the sector, therefore, the Government of Tanzania formulated NGUMP to coordinate rational and effective utilization of natural gas for both domestic and export markets for mutual interest of nation and investors.

1.2 Natural Gas in the World of Energy

Natural gas is a fossil fuel naturally occurring as a gaseous mixture of light hydrocarbons in sedimentary rocks. Main constituents of natural gas are methane, ethane, propane, butane and pentane with other non-hydrocarbons compounds including carbon dioxide, hydrogen sulphide, nitrogen and rare gases found in small quantities.

Natural gas is measured in cubic meters or cubic feet under standard conditions, defined at atmospheric pressure of 1.01325 bar (101.325 kPa or 14.696 psi) and a temperature of 288.15 K (15°C or 59 °F). The energy released by burning a volume of natural gas at standard conditions is measured in British Thermal Units (BTUs). The value of natural gas and indeed of most fossil fuels is determined by its energy contents, measured in BTU or calorific value. A cubic foot of natural gas at standard conditions has a range of 550 to 1500 BTUs, depending on its composition.

According to BP Statistical Review of World Energy 2015, the total global proven reserves at end of 2014 stood at 187.1 trillion cubic metres (6,607.4 TCF), with a reserve to production ratio estimated at 54.1 years based on the current consumption of 3500 BCM per annum. Similar statistics in Table 1.1 reveal that, three countries account for nearly 50 percent of the total world's proven reserves of natural gas, which are Iran (18.2 percent), Russian Federation (17.4 percent), and Qatar (13.1 percent).

Table 1.1: The top 10 World Proven Gas Reserves at end of 2014

Sn	Country	Proven reserve (TCF)	Share of total (%)
1	Iran	1,201.4	18.2
2	Russian Federation	1,152.8	17.4
3	Qatar	866.2	13.1
4	Turkmenistan	617.3	9.3
5	USA	345.0	5.2
6	Saudi Arabia	288.4	4.4
7	United Arab Emirates	215.1	3.3
8	Venezuela	197.1	3.0
9	Nigeria	180.1	2.7
10	Algeria	159.1	2.4

Source: BP Statistical Review of World Energy 2015

In 2014, natural gas accounted for 23.7% of total world energy consumption, behind oil and coal that contributed 32.6% and 30.03%, respectively (Table 1.2). However, according to numerous literatures, natural gas is one of the cleaner fossil fuels and hence it is becoming more attractive as a future global energy source. It is considered that in comparison to coal and oil, natural gas emits only 50% and 25% less carbon dioxide (CO₂) per unit of energy produced respectively.

Table 1.2: The World Primary Energy Consumption in 2014

Sn	Energy source	Consumption (Mtoe)	Share of total (%)
1	Oil	4,211.1	32.60
2	Coal	3,881.8	30.03
3	Natural gas	3,065.5	23.70
4	Hydro electric	879.0	6.70
5	Nuclear energy	574.0	4.44
6	Renewables	316.9	2.45

Source: BP Statistics Review of World Energy 2015

Based on the preceding review, discovery and use of natural gas in the world is not a new phenomenon. Hence, Tanzania does not need to re-invent the wheel, but to adapt from known principles and strategies for prudent harnessing and management of the resource to boost development of the country and its people.

1.3 Vision and Mission for NGUMP

1.3.1 Vision

A vibrant and competitive natural gas industry contributing significantly to broad-based growth and socio-economic transformation of Tanzania.

1.3.2 Mission

To create enabling conditions for the supply and effective utilization of natural gas to all market segments across the entire value chain in a reliable, transparent, effective, safe, sustainable and environmentally friendly manner.

1.4 Objective of the NGUMP

1.4.1 Main Objective

To develop framework for rational and efficient utilization of natural gas to all sectors of the economy for maximum benefit and alleviate poverty to Tanzanian society.

1.4.2 Specific Objectives

- a) To identify current and future demand and supply of natural gas for local and foreign markets;
- b) To set framework for development of infrastructure to supply the market;
- c) To set financing strategy for gas utilization projects;
- d) To develop framework for rational and efficient utilization of natural gas to all sector of the economy for maximum benefit and alleviate poverty to Tanzanian society;
- e) To promote the use of natural gas as alternative fuel to charcoal and wood for domestic use, feedstock for value added products, industrial heating, power generation and in the transport sector
- f) To reduce foreign currency expenditure by replacement of imported liquid fuels;
- g) To promote the natural gas long term self-sufficiency, security of supply and environmental friendly activities along the value chain; and
- h) To promote local content in the natural gas value chain.

1.5 Pillars of NGUMP

NGUMP focuses on four major aspects for development: economic and institutional aspects; financing and tax aspects and environmental; social development issues and capacity building and technology transfer. Indeed, sustainable development is characterized by the harmonious combination of these three dimensions, which are pillars of this NGUMP. Certain strategic objectives linked to these pillars have to be met in order to realize the desired results. These are detailed in Table 1.3 below.

Table 1.3: Pillars of NGUMP and its Strategic Objectives

Pillars	Strategic Objectives
Economic and Institutional Aspects	• Identifying current and future demand and supply of natural gas for local and foreign markets; • Ensuring the availability of gas for the domestic market is facilitating the industrialization of the country; • Facilitating the integration of natural gas industry and other economic sectors in the country in order to accelerate broad based growth and socio-economic transformation; • Promoting the use of natural gas as alternative fuel to liquid fuel, charcoal and wood for domestic use; • Increasing institutional expertise in matters related to gas, including exploration, development and marketing of natural gas; and • Increasing capacity building and local content in matters related to natural gas value chain.
Financing and Tax Aspects	• Establishing financing strategies for the development of gas projects and for local development initiatives; • Continuous improvement of the fiscal regime regarding natural gas development projects; and • Ensuring realization of adequate Government share of natural gas, both in kind and cash.
Environmental and social development	• Ensuring adequate disaster management systems to prevent adverse impact and protect people's health, safety and environment; • Ensuring that the local communities, in particular in the areas of exploration and production, are benefiting from natural gas-related activities; • Creating and/or increasing the environmental awareness of local communities; • Emphasizing on mitigation of environmental damages resulting from the production and use of natural gas;

Pillars	Strategic Objectives
Capacity building and technology transfer	• Strengthening institutional capacities for the implementation of applicable legislations; and • Facilitating training and capacity building of the national workforce.

1.6 Values

To enable the Government implement its mission and finally attain its vision, it shall be guided by a set of core values, namely:

- i. **Transparency.** All decisions to be taken, agreements to be concluded, and all other practices, should be transparent and designed to benefit the society in general.
- ii. **Social justice and equality.** None of the actions carried out within the scope of implementation of the Master Plan can promote social exclusion; and should, in particular, benefit the disadvantaged communities.
- iii. **Participation and information access.** The Government should promote equitable participation, according to the capacities of each stakeholders, on issues related to the sustainable use of gas. Any information that does not interfere with the sovereignty of the country will be freely accessible to stakeholders, either individually or collectively.
- iv. **Accountability.** The Government will use legal, policy and ethical standards to underscore the importance of holding individuals accountable in the use of public funds for the implementation of NGUMP and making progress on intended results.
- v. **Effectiveness.** The Government will work with private sectors to promote the implementation of NGUMP.
- vi. **Results oriented.** The Government will emphasize competencies and set priorities that will support effectively contribute implementation of the master plan.
- vii. **Integrity.** All stakeholders are expected to be honest, ethical and objective in all deliberations, actions and decisions.
- viii. **Responsibility.** The Government will take responsibility for successes and failures of the master plan and will be accountable to the public.
- ix. **Loyalty.** All stakeholders shall be committed and devoted to the implementation of this master plan.

1.7 Guiding Principles

NGUMP sets out the following principles to be observed, which by their nature, are decisive for the harmonious development of the country:

- i. **Project initiation:** in accordance with Petroleum Act, 2015 Section 9(2)(k), the NOC has the exclusive rights to implement this master plan and hence mandated to initiate all natural gas utilization projects prior to implementation.
- ii. **Regulatory Clarity:** Clear definition of the responsibilities and mandate of regulators. This will have a positive impact on investment decisions, especially in upstream, midstream and downstream natural gas projects.
- iii. **Coordination of Infrastructure development:** It is necessary to define how the supporting infrastructure for the development – electricity, ports, roads, railways, airports - needs to be created based on the gas production and use.
- iv. **Education and Training:** A critical mass of Tanzania professionals commensurate with the demand of the natural gas industry need to be produced. Continuous efforts of technical training and education in general must be made in the specialties to support the natural gas industry.
- v. **Promotion and inclusion of SMEs:** Natural gas is an attractive fuel for SMEs, for its uses in heat production and as raw materials. It can also stimulate the production process that allows them to be internationally competitive. Appropriate mechanisms to encourage the use of gas for the development of SMEs should be adopted.
- vi. **Environmental Sustainability:** Lessons learned from some countries show that there can be no development if the exploitation of resources damages the environment and traditional livelihoods. The Government's approach to the development of the gas market has been, and will be, implementing a policy of sustainability and environmental protection. This is doubly important where offshore projects are implemented, and may affect fisheries and tourism.
- vii. **Use of Local Resources:** The use of local resources such as raw materials, labour force, national companies and domestic enterprise services, should be prioritized in order to raise people's living standards and technology transfer.
- viii. **Community Integration:** Gas related development projects must facilitate improvement of social and economic welfare of the communities that will host those projects.

CHAPTER 2. LINKAGES OF NATURAL GAS WITH OTHER STRATEGIC SECTORS

Natural gas has multiple linkages (backward and forward) with other sectors and sub-sectors of the economy such as forestry, agriculture, transport, education, health, mining, tourism, commerce, manufacturing, and energy. In addition, activities in the natural gas industry, such as exploration, construction and system operations will further create demand for labor, goods and services.

Employment to be associated with the entire value chain of natural gas businesses is classified under two main categories: the direct and indirect employment. The Natural gas sector will create direct employment at upstream, midstream and downstream levels during petroleum explorations, development, construction and operation of the facilities.

2.1 Forestry

According to Energy Policy 2015, Tanzania energy mix is about 90% biomass based resulting into annual average deforestation of 350,000 hectares (TFC website 2015). According to UNEP report 2014, forestry industry contribution to the GDP has increased considerably during the past ten years by about 35% from 2.6 -3.4% of the GDP. In addition, forests support the development of other important sectors such as agriculture and tourism through provision of water resources and catchments, maintenance of hydrological balance and soil protection. Further, the forest stabilizes the essential balance of atmospheric gases.

The use of natural gas as an alternative to wood fuel for cooking will contribute to the reduction of deforestation rate, thus mitigating climate change (improved rainfall, predictable rainfall seasons, reduced natural catastrophes), resulting in reduction of environmental degradation leading to improved agricultural productivity. The improved agricultural productivity will guarantee food security, stimulate value additions in the food value chain and improve livelihood of rural communities. Such developments may have additional multiplier effect creating more opportunities.

2.2 Agriculture

In accordance with the World Bank report 2013, Tanzania economy depends on agriculture accounting for more than one quarter of GDP (27-32%), providing 85% of the export and employing 80% of the workforce in the country. Agriculture will benefit through application of natural gas in the establishment of fertilizer, agrochemical industry and power generation.

The establishment of a robust fertilizer and chemical industry to produce critical agricultural inputs within Tanzania will ensure supply of inputs and forward linkages to processing, packaging and marketing of agro-products. Availability of fertilizer will increase its wider application resulting in higher productivity in the agricultural sector.

Increased and more reliable power supply in the rural areas will enable establishment of small (cottage) processing industry and support preservation of food crops especially fruits and vegetables. This may open up opportunities for the farmers to supply high end markets which require high value food crops. It may also open up opportunities for export of processed goods and expansion of the food processing industries in the country increasing foreign currency earnings and creating higher employment opportunities.

2.3 Education

The discovery of natural gas has created needs for specialized skills in the labour force. This has necessitated our local research and training institutions to reorganize and start building capacity in the respective areas. There are emerging opportunities for training outside the country in areas where local capability of the institutions is inadequate. Many institutions have initiated training programmes that are geared towards serving the oil and gas industry and the associated industries. Further, additional skills are required for the government regulatory and monitoring organs that are also reorganizing to be able to meet the challenge that is posed by the discovery of the natural gas. The institutions are also compelled to engage in research that is relevant to the natural gas industry. This creates another demand for establishment of laboratories with adequate facilities for research. There is growing need for pulling together of resources to set up specialized institutions or Centers of Excellency dedicated to serve the industry.

As a consequence of all these transformations, there is increased interest in oil and gas related subjects with many students aspiring to eventually be able to serve the petroleum industry. Further, there is enhanced expansion of the employment base in the research and training institutions in the upper end, midlevel and lower level knowledge and skill spectrum.

2.4 Transport

CNG and other products derived from natural gas e.g. methanol, DME and gas to liquids are becoming attractive substitutes for replacing traditional transportation fuels such as gasoline and oil-produced

diesel. This may reduce the dependence on imported oil products and reduces CO₂ emissions from the transportation sector.

The use of CNG in transportation system is considered cleaner compared to other fossil fuels. The government intends to introduce public transportation system which depends on natural gas. Further, it is envisaged that electric trains and trams will be introduced as availability and reliability of electricity supply is improved by the use of natural gas in power generation.

2.5 Tourism

With the excellent natural environment, attractive national parks and substantial animal life, tourism has become a vital economic activity in Tanzania. The expected booming of natural gas industry will trigger development of transport infrastructure and hospitality industries which are a prerequisite to growth of tourism industry. Natural gas for cooking will enhance environmental protection through reduced deforestation. Forests provide food and shelter to the wild animals that attract thousands of tourists annually. Economics shows that use of natural gas for cooking by hotels will improve profitability as natural gas is cheaper than alternative fuels such as LPG and electricity. The profits generated can be used to improve services of hotels and attract more tourists.

2.6 Industrial sector

According to the Economic Survey Report 2014, the contribution of the manufacturing sector to the overall GDP of the country has averaged to 7.34%. The sector is currently the third most important to the Tanzania economy behind Agriculture and Tourism. Among others, shortage and unreliable power supply has been a most crucial factor straining industrialization growth in the country.

Natural gas finds direct and indirect application in industrial sector in a number of ways. The direct application involve its use as source of energy and feedstock in industries including: power generation, manufacturing of ammonia, fertilizer (urea), methanol, iron and steel mills, DME, and GTL. The growth of the Industrial power demand from gas is expected to accelerate the increased power consumption associated with industrial advances. Therefore good planning, timing and natural gas supply to this Industrial sector is of paramount important.

The indirect application involves its use further downstream in the industrial hierarchy. In this case the first products mentioned above are used as important feedstock/ingredient in the manufacture of other products including acetic acid, formaldehyde, gasoline, ethylene, propylene, polyethylene, methyl tert butyl ether (MTBE), paints, adhesives, resins, nitric acid, melamine, ammonium nitrate, and ammonium

phosphate. Many more products for household and industrial use are possible produced from natural gas.

Production of these products requires additional inputs that may be obtained from associated industries that may have to be developed. The sector has the potential to contribute substantially toward employment creation, exports, revenue generation and economic growth.

2.7 Power Sector

The use of natural gas for power generation has a multiplier effect to other strategic sectors of the economy. Adequate supply of natural gas for power generation will ensure adequate and reliable power to the country. This will attract more investment in the industrial sector since the reliable supply of electricity and tariff will be competitive, hence the products from the industries will also be competitive in the domestic and international markets. Agriculture sector will benefit from the reliable and relatively cheap power supply for irrigation schemes that will improve productivity. Furthermore, the adequate power generation from natural gas will replace the expensive power generation from liquid fuel, thereby increasing saving of forex that could have otherwise been used to import fuel. Availability of reliable electricity will generate significant opportunities for industrialization and rural electrification and hence improve social and public services.

2.8 Land and territorial sector

As stipulated in the Petroleum Act, 2015, (Section 148), that all natural gas processing facilities are to be located onshore, therefore, integrating the land issues in natural gas development programme is of great importance. Secure and predictable access to land is a key to long-term investments foreseen in natural gas sector. These requirement will, therefore, necessitate the Ministry responsible for Land to play its central role on establishing and implementing the Land Use Plans to accommodate various investments related to natural gas projects including way-leaves, sites for factories, LNG plant, storage facilities and other industrial business.

2.9 Services sector

This involves provision of services to the entire value chain of natural gas businesses. These services range from the highly technical support services of the actual exploration and production activities to the more mundane but essential services of food catering, waste disposal and transportation, among others. An additional strategy is required to stimulate and support entrepreneurship to enhance local

content to ensure that domestic producers are able to supply the skills, goods, and services required by the new industries.

In addition, other necessary services needed for supporting a buoyant natural gas sector include engineering services; financial services; insurance services; testing and inspection; environmental protection; shipping in the various forms; health care and insurance; logistics – including charter planes and helicopter services, warehousing, clearing and forwarding, travel agency; security; project management services; outsourcing personnel; supply of goods; equipment; laundry and general cleaning.

CHAPTER 3. GAS UTILIZATION OPTIONS AND DEMAND FORECAST

3.1 Domestic Natural Gas Utilization Options

Natural gas may be processed into many useful products that have vast market value. The initial process involves drying and cleaning of the gas to remove unwanted impurities. The most common use of natural gas is fuel. Natural gas is also used as feedstock in petrochemical industries where it is transformed into various derivatives including ammonia, methanol and liquid fuels. Some of these derivatives become feedstock and additives for numerous valuable industrial products.

In Tanzania, natural gas has been used as alternative fuel by power plants, industries, institutions and households. The use of natural gas for power generation and Industries started in 2004 while households and institutions started in 2009. In magnitude of consumption, power generation is the leading consumer followed by industrial utilization and very minor usage in institutions, households and vehicles.

Ninety percent of Tanzania's energy requirement is supplied from traditional fuels, mostly biomass involving firewood and charcoal. Most of households, institutions and industries use firewood and charcoal for cooking and running their boilers. Application of natural gas as an alternative fuel for cooking and heating will reduce deforestation which is currently at an average of 350,000 hectares annually according to 'Calls to Legalize Tanzania's Charcoal trade to serve forest (TFS 2015)'. Natural gas uses will also reduce environmental pollution and save foreign currency used to import liquid fuels.

Utilization options and demand for natural gas are estimated basing on various assumptions and studies undertaken by MEM and JICA. These options and estimates are discussed in detail below:-

3.1.1 Gas Based Power Projects: 2016-2045

Natural gas resource will play a major role in balancing the electricity production mix in Tanzania. Utilization of natural gas for power production started in 2004 when the Songo Songo gas to electricity project became operational. According to TANESCO, by 2015, the installed capacity connected to the national grid was 1,516 MW, out of which gas fired amounted to 711 MW, thermal amounted to 243.4 MW and hydropower accounted for 561 MW.

3.1.1.1 Projected Market Demand and Production Capacity

Electricity sector is the leading consumer of natural gas among all domestic users. According to the revised draft Power System Master Plan (PSMP) 2015, the installed capacity in Tanzania is projected to be 4,436 MW by 2020. It further projects that natural gas will contribute up to 40% to the generation mix which translates into installed capacity of the gas fired power plants to be about 1,774 MW. The NGUMP has adopted the PSMP projections of 30,755 MW by 2045 to estimate the corresponding natural gas requirement.

It is desired that, in order to comply with the Natural Gas Policy directives, from 2025 Government will encourage installation of Combined Cycle Gas Turbines (CCGT). The policy stipulates that natural gas resources should be used efficiently. Based on industrial practices and experience, 0.13 mmscfd generates 1 MW based on 57% efficiency for the CCGT and for the case of Simple Cycle Gas Turbine (SCGT) 0.2 mmscfd generates 1 MW based on 35% efficiency. It is further assumed that, of all installed capacity of gas turbines, SCGT and CCGT will take a share of 50% each. The resulting demand for natural gas under this assumption is forecasted at 8.8 TCF over a period of 30 years.

A typical investment requires approximately US\$200 million for construction of a 200 MW facility, resulting in a CAPEX ratio of US\$ 1,000/kW (rule of thumb). Some economies of scale exist for larger plants. In order to comply with PSMP projections, there shall be an installed capacity of about 1,774 MW based on gas fired generation by 2020, which will then increase to 12,302 MW by 2045. That means, by 2020, an additional investment of about 1,063 MW is required from current existing capacity of 711 MW as depicted in Table 3.1. This will require about US\$ 1.063 billion.

Table 3.1: Gas Fired Power Plant Capacity

Year	Total Installed Capacity (MW)	Gas fired capacity (MW)	Additional Capacity Required (MW)	Source
2015	1,516	711	-	Actual (TANESCO)
2020	4,436	1,774	1,063	PSMP projection
2045	30,755	12,302	10,528	PSMP projection

3.1.1.2 Viability

The envisaged capacity additions to realize PSMP projections will depend on availability of funding for the earmarked projects.

3.1.2 Industrial Application as an Alternative Fuel

Natural gas is used as fuel to fire boilers and furnaces in the glass, textile, food processing, beverage (cold drinks and spirits/beer) and other facilities which require energy in their manufacturing processes. There are 37 industries which are currently connected to the gas distribution network in Dar es Salaam that started in 2004. Potentially, an addition of about 100 industries can be connected to the natural gas distribution network to use natural gas as an alternative fuel in Dar es Salaam. The current industrial average natural gas consumption is 10 mmscfd, equivalent to 3.65 BCF per annum.

3.1.2.1 Projected Demand

Gas demand forecast for industrial use as fuel is projected based on the average regional demand as per the market study undertaken in 2011 by MEM in 11 regions of Tanzania. The study projected that in 2016, the natural gas demand for light industries will be 0.076 TCF. For the purpose of this plan, it is assumed that the gas demand for light industries will grow at 3% annually based on similar experiences from Dar es Salaam industrial gas consumption. This makes a total natural gas demand of 3.6 TCF from 2016 to 2045.

3.1.2.2 Viability

The gas demand has been projected based on Dar es Salaam industrial growth experience, however this can be qualified based on other regional economic parameters that may be generated through industrial surveys.

3.1.3 Households, Institutions and Transport

The use of natural gas for households, institutions and transport is projected to expand gradually. Tanzania being a tropical country with relatively high temperature throughout the year, will presumably use natural gas for cooking and cooling (central cooling systems) rather than space heating which consumes high amount of natural gas during the cold winter seasons in some countries.

Demand of gas at household level for cooking may tend to be small due to related investment and operational costs compared to traditional cook stoves. However, the importance of supply of gas as an alternative energy to biomass (mainly charcoal and firewood) makes it necessary for the Government to strategically intervene and promote its implementation through appropriate policies in order to save the fast depleting natural forests.

3.1.3.1 Gas Demand for Households

In forecasting households demand for natural gas, based on TPDC pilot project in Mikocheni area, a typical household consumes 35.5 scfd for cooking. According to the 2012 population census report, Tanzania has about 9,000,000 households with a household size of 5 persons. It is assumed that from 2016 – 2045 the population will, on average, be growing at 1.95% per annum. It is further assumed that 10% of households in the country will be supplied with natural gas for cooking by 2045. This makes a total demand of 0.5 TCF for 30 years.

3.1.3.2 Gas Demand for Institutions

Gas demand forecast for institutions is projected basing on the average regional demand as per the market study undertaken in 2011 by MEM in 11 regions of Tanzania. Institutions considered under this study include prisons, hotels, academic institutions, hospitals and health centres. The study projected that, in 2016, the natural gas annual demand for institutions will be 3.6 BCF. For the purpose of this plan, it is assumed that the natural gas demand will grow at 2% annually, hence making a total demand of 0.1 TCF between 2016 and 2045.

3.1.3.3 Compressed Natural Gas for Transport

Available data shows that out of about 700,000 vehicles registered from 2004 to 2014, sixty percent (60%) use petrol as fuel. These vehicles are potential candidates for conversion to Compressed Natural Gas Vehicles (CNGV). It is assumed that 20% of all petrol vehicles will be converted to use natural gas. To forecast the CNGV demand, it is assumed that a typical vehicle will on average demand 7 liters of petrol per day, which is equivalent to 225 scfd of natural gas. The number of vehicles will grow at the GDP growth rate, which on average is assumed 6.1%, thus making a total demand of 0.6 TCF for 30 years. Further studies should be undertaken to determine the approximate demand and growth patterns.

Therefore, based on the above information, the forecasted demand of natural gas for households, institutions and transport is about 1.2 TCF for the period thirty years.

3.1.3.4 Viability

The Government intends to supply natural gas to its citizens to alleviate impacts associated with use of traditional biomass and conventional oil. However, due to inadequate infrastructure this exercise may be costly and can be realized in the long term. It is therefore necessary to carry out appropriate studies to determine cost effective mechanism of supplying gas to the public.

3.1.4 Fertilizer (Ammonia & Urea)

Tanzania imports 90% of its field grade fertilizers, the remaining 10% is domestically produced. However, the domestically produced fertilizer is only suitable for acidic soils, although the products' demand is constrained by the slow agronomic response to crops which is observed in the season following application. Consumption of fertilizer from 2010/2011 to 2014/2015 has averaged 306,450 tons per annum, where urea is by far the most used fertilizer accounting for above 33% of the total field grade usage in Tanzania (Table 3.2). However, the Ministry responsible for Agriculture estimates the fertilizer use will grow to 485,000 tons per year in 2016.

Table 3.2: Consumption of fertilizer by type from 2010/2011 to 2014/2015

Type of fertilizer	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015
SA	4,002	4,126	3,178	4,449	4,378
CAN	14,359	12,808	9,853	13,794	11,864
UREA	100,465	69,000	65,855	153,024	127,786
TSP	785	1,436	728	1,019	1,270
DAP	42,909	69,918	21,000	75,612	68,387
NPK 20:10:10/10:10:10	2,868	9,540	2,416	45,701	42,315
NPK 25:5:5	9,499	10,142	6,027	5,696	5,977
NPK 6:20:18/10:18:24	49,238	45,624	40,584	42,318	46,083
NP K 17:17:17	26,754	27,938	13,834	19,367	27,668
MRP	30,806	20,338	64,000	3,952	0
MOP	1,581	1,319	894	0	1,796
Others	1,370	19,374	9,480	13,272	2,476
TOTAL	284,636	291,563	237,849	378,204	340,000

Source: Ministry of Agriculture, Livestock and Fisheries, 2015

This consumption is however very low at about 10kg/ha compared to the Abuja Declaration which emphasizes a minimum of 50kg/ha by 2015 for Sub-Saharan countries. The fertilizer consumption should increase in order to improve agricultural productivity and to meet increased consumption of food due to population growth. Surplus urea, can be exported to neighboring countries or readily delivered into the present global market. The fertilizer project can be viable at relatively small investment. A typical flow diagram for ammonia production is depicted in Fig. 3.1 below.

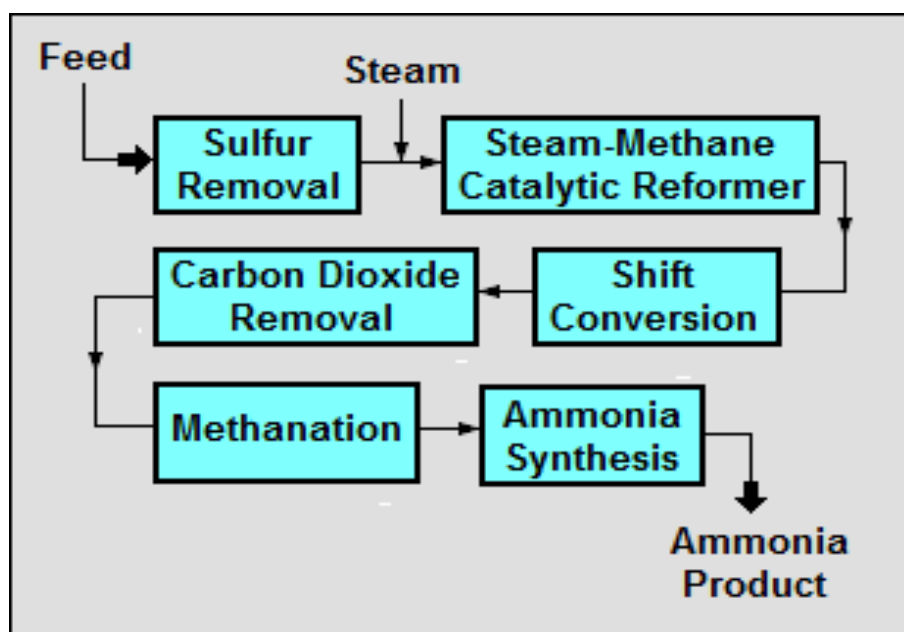


Fig. 3.1: A typical flow diagram for ammonia production

Ammonia is a poisonous gas having a boiling point of -33.3°C at room temperature and pressure and therefore it requires proper handling to mitigate any potential hazards. Apart from production of fertilizer and other chemicals, ammonia also finds application in melamine (for home utensils), polymers and refrigerants (Fig. 3.2). It is common to produce ammonia, urea and melamine in an integrated facility where ammonia feeds to the urea and melamine plants.

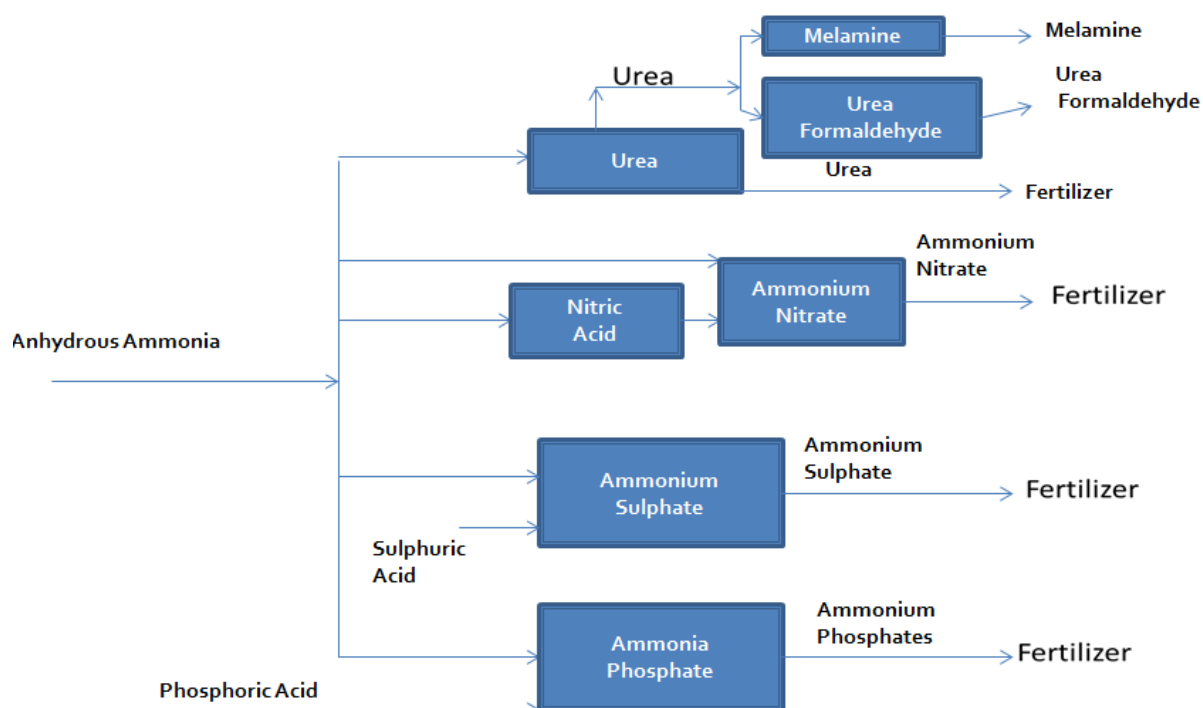


Fig. 3.2: Derivative products of ammonia

3.1.4.1 Projected Market Demand and Production Capacity

The Ministry responsible for Agriculture estimated that the demand for fertilizer in Tanzania will increase to 485,000 tonnes in 2015/16, up from an average of 245,900 tons per annum during the period 2009/10 to 2012/13. Urea accounts for one third of the total fertilizer application in Tanzania. Due to sensitivity of fertilizer company's revenues to natural gas feed stock cost and the global ammonia/urea prices, fertilizer profitability tends to rely on economies of scale in order to remain competitive.

The current world scale Urea plant that can benefit from economies of scale is capable of producing ammonia 2300 t/d and urea 4000 t/d (equivalent to 1.3 million t/y of urea). The plant output will satisfy the local market demand and export the surplus to regional and international markets. Based on the current investment cost estimates, the total CAPEX required will be USD 1200 million (total EPC cost – for Ammonia and Urea Complex and other Utility/Offsite Facilities). This plant will require natural gas supply for feedstock and captive power plant amounting to 0.7 TCF over 25 years (approximately 80 mmscfd). The project is estimated to offer up to 1400 jobs during construction with a potential of sixty (60) direct employment and 400 indirect jobs during operation. Ammonia/Urea plant is proposed to attain commercial operation date in year 2020.

3.1.4.2 Further Work

Detailed economic parameters of the ammonia/urea plant shall be established through comprehensive feasibility study that among other things will determine price trend of urea fertilizer, natural gas pricing mechanism and recommend the requisite feed gas price.

3.1.5 Methanol

Methanol is a light, volatile, colorless, flammable, and toxic liquid. It is produced by reactions of steam and methane in the presence of catalysts. It is used directly as a chemical and a raw materials for producing various conventional chemical products, as well as an intermediate materials in producing synthetic fuel products such as gasoline. Currently, there is no production of oil in the country, instead Tanzania can produce gasoline or DME by using methanol as raw materials. Methanol is easily transported using trucks, ships or trains. A flow diagram showing production of methanol from Natural Gas (Methane) is depicted in Fig. 3.3 below:

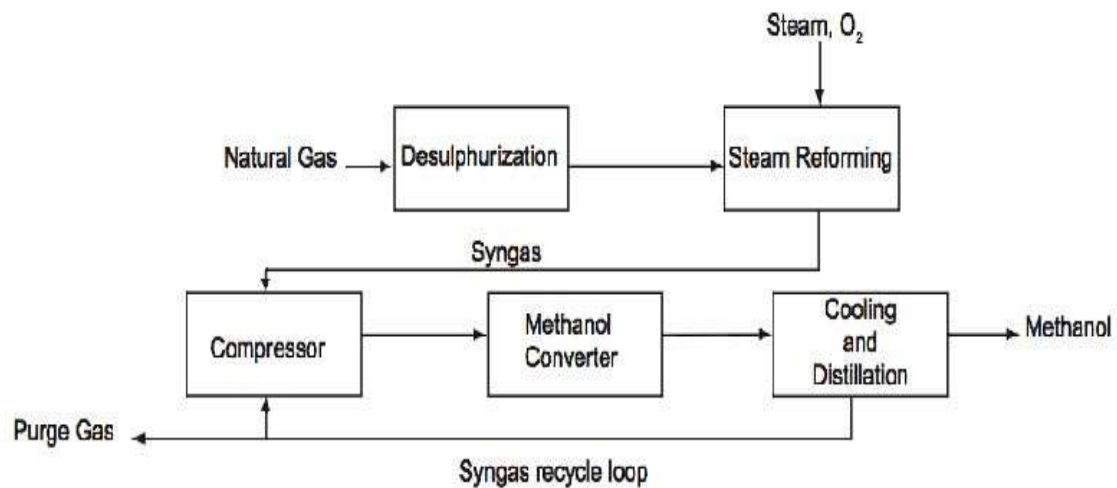


Fig. 3.3: Natural Gas to Methanol flow diagram

There are a lot of possibilities for utilizing and further processing methanol. It may be processed into polypropylene, polyethylene, formaldehyde, olefins, Dimethyl ether (DME), acetic acid, methyl amines, methyl methacrylate, and gasoline fuels. Many more derivatives can be obtained from the products listed below (Fig. 3.4). As an example, acetic acid can be further processed into vinyl acetate, polyvinyl acetate, acetic anhydride, acetate esters that are applied in pharmaceuticals, plastics, paints, inks, coatings, adhesives, polyester fibres, films, and plastic containers.

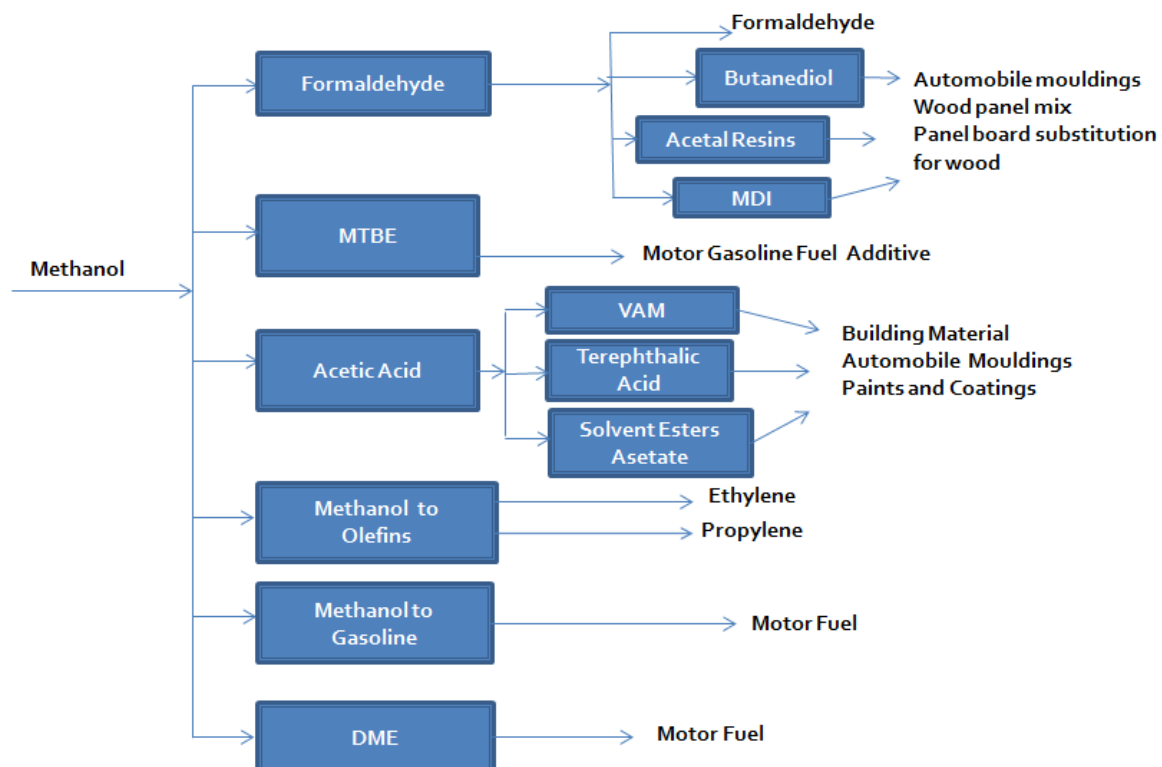


Fig. 3.4: Industrial products utilizing methanol as the main feedstock

The establishment of the methanol plant therefore, opens up possibility for setting up of secondary plants to produce the mentioned products. Basically each of the major products mentioned above translates into a major industry. The process has a significant multiplier effect in the industrial development.

3.1.5.1 Projected Market Demand and Production Capacity

Methanol is distributed from gas producing regions such as The Middle East, CIS, South America, and Southeast Asia to consuming regions such as Europe, North America, Far East, and China. According to Methanol Market Services Asia (MMSA Pte Ltd. Feb 2015), the global methanol market was about 72 million tonnes in 2014, of which approximately half being traded internationally, and is predicted to reach approximately 107 million tonnes in 2019. China is known to be the leader in production of methanol (producing over 50%), but it is also the leading consumer and therefore a major potential market for methanol from Tanzania.

Currently, Tanzania has no methanol plants and imports only about 50 tonnes of methanol annually. In Africa, reliable projections show that demand for methanol is increasing and hence, there is potential for developing methanol value chain in Tanzania. In case that methanol is produced at a low cost from natural gas in Tanzania, it could be exported to neighboring countries and further to the global market, and could potentially develop chemical industries starting from methanol as a feedstock. This may involve DME, MTO, MTG, and Methanol to other chemical products (e.g. plastics, paints, pharmaceutical and adhesives).

The scale of methanol plants has been increasing significantly, and their capacity has reached 3,000 to 5,000 tonnes/day (1.0 to 1.7 million tonnes/year) per single train. The consumption of natural gas in producing 3,000 tonnes/day of methanol is approximately 100 MMSCFD (about 0.7 Tcf over 20 years), which is comparable to that of ammonia - urea plants. A two trains (1 MTPA) plant is proposed, whereby the first train will be on stream by 2023 and the second train will come after 10 years. The CAPEX for initial investment of one train is projected at US\$ 900 million and a total of 1.1 TCF of natural gas will be required for production of methanol for two trains a period of 23 years.

Methanol business exhibits relatively stable profitability with respect to changes in construction costs. On the other hand, the profitability of methanol business heavily depend on the product prices. Further, production of methanol is likely to offer direct jobs between 1000 to 1400 jobs. Additional employment opportunities are offered by the downstream plants that use methanol as feedstock. The methanol plant should preferably be located in the areas where supply of gas can be ensured.

3.1.5.2 Further Work

The local methanol market is seen to be growing as demand for petrochemical products into the economy grows. A further study is required to establish viability of the project with latest details on price and other parameters.

3.1.6 Di-Methyl Ether (DME)

DME is a relatively new secondary product whose major feedstock is methanol, produced either through dehydration of methanol or direct synthesis from syngas. It is gaining its popularity as fuel for power generation, transport fuels, domestic fuel similar to liquefied petroleum gas (LPG), aerosol properants, industrial fuel and chemical feedstock. DME burns more cleanly and is also more efficient than diesel. It can also be formed from organic sources (biomass) and is therefore carbon neutral. It is considered virtually nontoxic, and although flammable, is no more dangerous to handle than gasoline. However, unlike methanol, DME has a high enough cetane number to perform well as a compression-ignition fuel. Also unlike methanol, DME is a gas at ambient temperature and pressure, so it must be stored under pressure as a liquid similar to LPG. When used as a diesel fuel, DME provides reduced particulate matter (PM) and NO_x emissions, it helps to significant reduce CO₂ emissions but increased CO and hydrocarbons (HC). Methanol to DME flow diagram is depicted in Fig. 3.5 below:

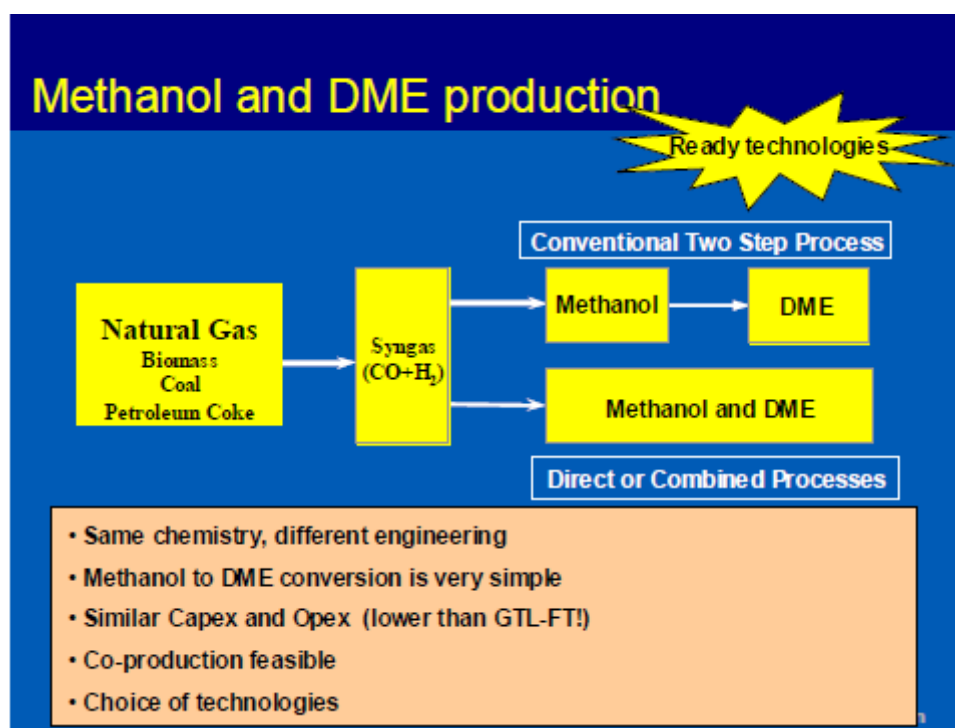


Fig. 3.5: Methanol to DME flow diagram

3.1.6.1 Projected Market Demand and Production Capacity

According to International DME Association (IDA), the global market for dimethyl ether has grown significantly during the past few years and is expected to grow at a more rapid pace in the next five years, mainly driven by growing demand in the Asia-Pacific region. China consumed more than 90% of the global dimethyl ether demand in 2012, which was majorly for fuel applications. The dimethyl ether market in other countries is emerging from past years and is expected to grow significantly in the future. Various countries like South Korea, Japan, Indonesia, Sweden, Egypt, and Trinidad & Tobago have their own respective focus to develop DME market by producing domestically or by sourcing it from other countries.

DME is reformed with steam at relatively lower temperature than natural gas and LPG, etc., and has some advantage on heat balance. Therefore, DME is a promising fuel for the fuel cell. Moreover, a compact reforming device has been developed for use by a fuel-cell car.

Tanzania anticipates producing sufficient and commercializing DME for blending it with LPG, so as to reduce its reliance on LPG imports and hence, minimizes hard cash expenditure on such imports, and also to capture potential export market. For the purpose of supplying to both domestic and export markets, a world scale DME plant with a nameplate capacity of 0.25 MTPA is proposed, with a natural gas demand of 0.3 TCF over a period of 23 years.

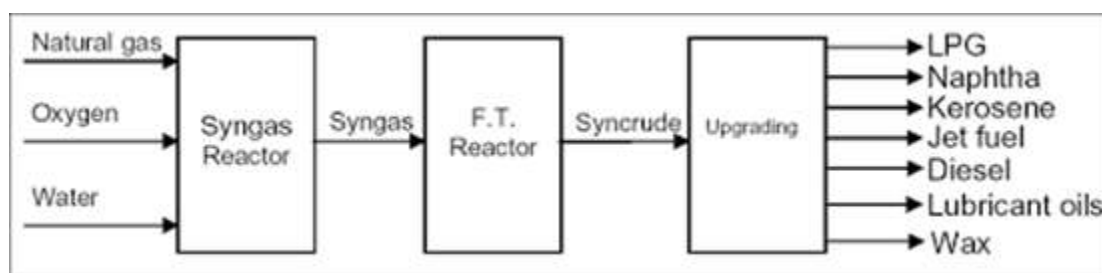
The estimated CAPEX for such plant is US\$ 65 million. A DME plant would best be located close to methanol plant. DME plant will be built after or in concurrence with the methanol plant, as methanol will be the main feedstock.

3.1.6.2 Viability

The major use of DME in Tanzania may be by blending with LPG for fuel purposes, and export market as demand dictates. The final market options and capacity will be determined through a feasibility study.

3.1.7 Gas to Liquid (GTL) Project

Gas-to-liquids (GTL) is a process that converts natural gas to high value liquid fuels such as gasoline, jet fuel, and diesel. GTL can also make waxes. The most common technology used at GTL facilities is Fischer-Tropsch (F-T) synthesis. Although F-T synthesis has been around for nearly a century, it has gained recent interest because of the growing spread between the value of petroleum products and the cost of natural gas.



Source: MEM, 2015

Fig. 3.6: GTL Process Flow Diagram

3.1.7.1 Projected Market Demand and Production Capacity

Potential demand for GTL products is massive in Tanzania as the country depends on 100% imports of these products. According to EWURA Annual Report 2014, the country consumed a total of 50,000 bpd equivalent to 2.9 billion litres per annum, where diesel accounted for 64%, petrol 25.7%, kerosene 0.7%, and other petroleum products in small quantities. These products can easily be produced in Tanzania using natural gas through GTL process.

A typical GTL plant (one train) has a capacity of producing 15,000 bpd comprising of Diesel Oil (55% = 8,250 bpd = 1.3 million liters per day), Naphtha (25% = 3,750 bpd) and Kerosene (20% = 3,000 bpd). Therefore, if investment in GTL plant was to happen based on the current demand, an ideal capacity to replace 100% of the reported quantities, particularly diesel and kerosene would require four trains producing up to 60,000bpd. This implies that by 2027, when GTL project is expected to be on stream, more capacity would be required to cater for the increasing demand.

However, due to high CAPEX of a GTL project, its viability including determination of plant capacity would normally be evaluated carefully based on the opportunity cost of importing versus producing locally the targeted white petroleum products. A quick analysis on possible minimum natural gas price in Tanzania, reveals that a GTL project can only be attractive when the oil price is not less than \$65/Bbl. Currently the oil price stands at about \$35/Bbl. However, assuming the oil price will rebound back to favourable thresholds before development of the offshore gas, a three train GTL plant to produce 45,000bpd has been proposed to limit CAPEX requirement. Each train will come on stream in the interval of 5 years from 2027 (ie. 2027, 2032 and 2037), to replace approximately 16% of imported diesel and kerosene between 2028 and 2036 and 12% of the same in 2037, basing on the demand forecast as shown in Table 3.3. GTL project will require 1.8 TCF of natural gas between 2027 and 2045.

Table 3.3: Selected GTL Products

	2028 (2 trains)			2037 (3 trains)		
	Demand	GTL	Ratio	Demand	GTL	Ratio
	bpd	bpd	%	bpd	bpd	%
Domestic (Kero+Diesel)	142,700	22,500	15.8	286,000	33,750	11.8
Export (Naphtha)	-	7,500		-	11,250	

Source: IEEJ, 2015

A proposed three trains GTL plant (15,000bpd each) will have overall CAPEX of US\$ 6,220 million. Further expansion may be preferred depending on the economics which will largely be driven by the prevailing global oil prices.

3.1.7.2 Further work

For a country like Tanzania that imports all white petroleum products but has abundant natural gas, GTL project is proposed as one of monetization options. GTL plant involves a greater amount of capital and operation expenditure, making it not highly profitable. Moreover, in order to be profitable GTL project depends on high oil prices as well as low gas prices. Given this nature of GTL project, a thorough feasibility study is needed before the investment decision.

3.1.8 Methanol to Gasoline (MTG)

Methanol to Gasoline (MTG) refers to processes which convert methanol into gasoline. MTG is an efficient route which uses methanol as an intermediate product from natural gas to produce high value gasoline that can be directly utilized to power vehicles in place of petroleum refinery gasoline. Under optimal conditions a high octane clean gasoline that meets industry standards is produced from Methanol.

MTG is the logical choice for Tanzania natural gas monetization since we already have a plan to have a methanol plant which will supply methanol to the MTG plant. MTG process will offer an important alternative route for fuel supply to the existing transportation market in Tanzania.

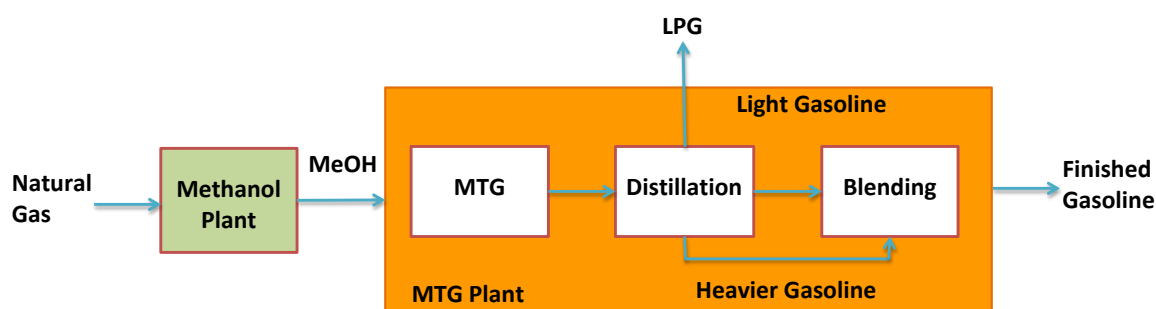


Fig 3.7: Process Flow for MTG (Source; IEEJ, 2015)

3.1.8.1 Projected Market Demand and Production Capacity

Potential demand for MTG products is high in Tanzania as the country depends on 100% import of white petroleum products. According to EWURA Annual Report, 2014, the country consumed a total of 50,000 bpd equivalent to 2.9 billion litres per annum, where gasoline accounted for 25.7%, diesel 64%, kerosene 0.7% and other petroleum products in small quantities. Gasoline which accounted for 25.7% translates into 12,842 bpd.

A typical MTG plant with nameplate capacity of 0.23 MTPA can produce 6,350 bpd of gasoline and 29,000 tons per year of LPG. This implies that if investment on MTG was to be undertaken based on this demand, it would require at least two trains to replace all import of gasoline. Since the MTG plant is proposed to be on-stream in 2023, more trains would likely be required to cater for the increasing demand. However, due to high CAPEX of MTG project, its viability including determination of plant capacity would normally be evaluated carefully based on opportunity cost of importing versus producing locally the targeted white petroleum products. Assuming that conditions will be favourable, single train MTG plant (0.23 MTPA) is proposed to be undertaken in 2023. It is estimated that MTG will consume 0.4 TCF of natural gas over a period of 23 years. Gasoline produced from MTG plant will replace a significant amount of imported gasoline, approximated to be 27% of Tanzania domestic demand for gasoline in 2023. It is also expected to replace the import of LPG by 36% in 2023 as shown in Table 3.4.

Table 3.4: Share of MTG Products in the Domestic Market

		Production from MTG Plant	Demand Forecast (2023)	MTG Ratio (%)
Gasoline	bpd	6,350	23,500	27.0
LPG	t/y	29,000	80,000	36.3

Source: IEEJ, 2015

The overall CAPEX of the proposed plant is estimated to be US\$ 330 million if feed methanol is purchased, and US\$ 869 million if feed gas is purchased to produce methanol.

3.1.8.2 Further work

For Tanzania which imports all white petroleum products but has abundant natural gas, MTG would be one of monetization options. However, since MTG project depends on high oil prices as well as very low gas prices to be profitable, a thorough feasibility study is needed.

3.1.9 Iron and Steel Complex

Tanzania has abundant Iron Ore with currently proven reserve of 300 million tons. The ore is mainly found in Liganga, Ludewa District over 800 Km from Mtwara and Lindi where natural gas has been discovered. Direct-Reduced Iron (DRI) and Hot-Briquette Iron (HBI) can be produced using natural gas as a reducer of iron oxide resulting into high quality output which is ideal for conversion to steel.

This creates a potential for Tanzania to implement an iron and steel complex comprising a pelletizing plant, HBI plant and a steel slabs and rolling mill. HBI will be sold to the domestic market for steel manufacturing or for export. However, iron-ore deposit is located very close to coal deposit and therefore coal can be utilized instead of natural gas.

3.1.9.1 Projected Demand

A world scale iron and steel plant producing 2 million tonnes of steel per annum requires 150 mmscfd. Since iron deposits are located close to coal deposits, it is anticipated that coal will be used for iron and steel industry. However, for flexibility of project implementation, 1.1 TCF of Natural Gas has been estimated for a period of 23 years.

3.1.9.2 Viability

The plant can either be located close to the iron ore deposit or close to the gas field location. Developing an enabling infrastructure to either transport gas from Mtwara/Lindi regions to Ludewa or a railway line to transport iron ore to Mtwara/Lindi will be pre requisite to the iron and steel complex.

Table 3.5: Summary of Petrochemical's Plant Capacities and Gas Consumption Projection

Category	Plant Capacity	No. of trains	Start-up year	Gas consumption per train (mmscfd)	Total Gas demand (TCF)
Fertilizer (Ammonia and Urea)	1.3MTPA	1	2020	80	0.7

Category	Plant Capacity	No. of trains	Start-up year	Gas consumption per train (mmscfd)	Total Gas demand (TCF)
Methanol	1.0MTPA	2	2023 2033	100	1.1
GTL	15kbpd	3	2027 2032 2037	134	1.8
DME	0.25 MTPA	1	2023	100	0.3
MTG	0.23 MTPA	1	2023	62	0.4
Iron and Steel	2.0 MTPA	1	2023	150	1.1

Source: IEEJ, 2015 and MEM, 2015

From the above table, further studies may be undertaken to refine the plant capacities, demand projection and project commencement periods.

3.2 Export Options

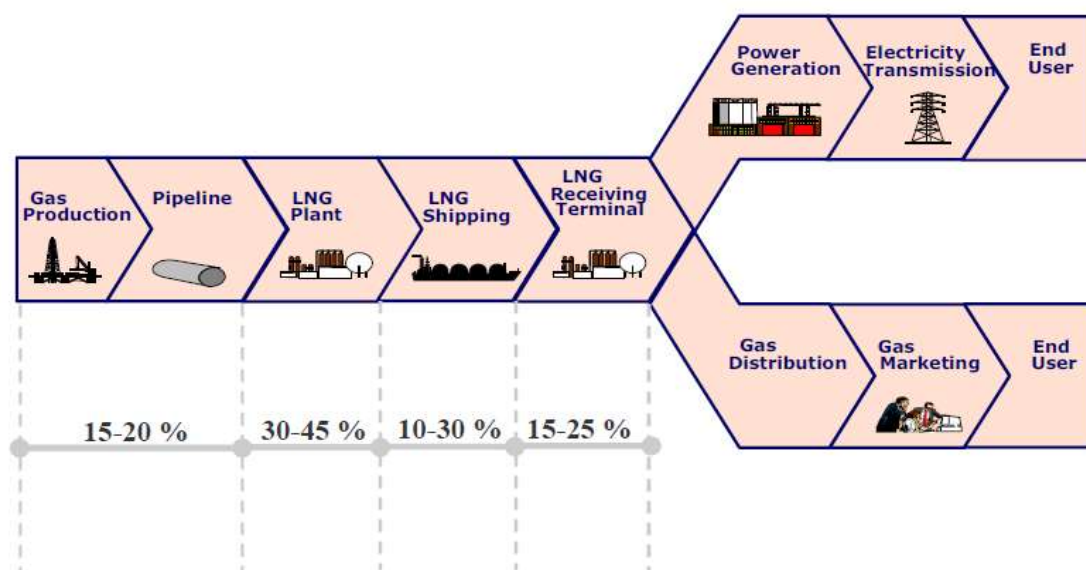
3.2.1 Liquefied Natural Gas

LNG is liquefied natural gas, a clear, colorless, non-toxic liquid that forms when natural gas is cooled to -162°C (-260°F). This shrinks the volume of the gas to 600 times, allowing for large amounts to be stored or transported over a long distance via special designed cryogenic ocean tankers (LNG carriers) or cryogenic road tankers. However, associated hazards include flammability, freezing and asphyxia.

Prior to its uses, LNG has to be re-gasified to its gaseous state. Thereafter, LNG is distributed to be used for residential, commercial and industrial sectors for purposes as diverse as heating and cooling homes, cooking, generating electricity and manufacturing paper, metal, glass and other materials.

The LNG "value" or "supply" chain consists of exploration and production (or E&P); processing; liquefaction; shipping - from the point of liquefaction to the final destination; and receiving, storage, regasification and distribution to end users. A schematic diagram showing the LNG value chain is as presented in Fig. 3.8 below.

LNG Value Chain



Typical cost Distribution in the LNG value Chain – (numbers are confirmed by different sources)

Fig. 3.8: LNG value chain

3.2.1.1 LNG Production and Market Overview

According to International Gas Union (IGU) World LNG report 2014, LNG production in the world has grown steadily from 50 MTPA in 1990 to 246 MTPA in 2014 and its demand projection is expected to grow by 7.6% each year to reach 500 MTPA in 2030. Despite expected growth in demand, it is likely that there will be market volatility for LNG worldwide due to current developments in US, Australia and Mozambique. Hence, the market may be very challenging for new upcoming projects like Tanzania.

Global demand for natural gas is continuing to increase as economy in both developed and emerging countries continue to grow. Areas such as Europe, India, China, South Korea, Taiwan and Japan are leading the overall future demand for LNG, as they convert to cleaner and more cost competitive energy sources to fuel their economies. According to the International Energy Agency (IEA), global demand for energy is expected to rise by 40% by 2035. This includes a 55% increase in demand for natural gas.

Tanzania is strategically located close to those markets where most of the demand growth is expected. Therefore, the expected potential markets for Tanzania LNG could include Japan, China, South Korea and India (Asian).

3.2.1.2 Prerequisites for LNG Project

Tanzania is considering to implement an LNG project due to the following:-

- a. It is considered to be the most viable monetization option of the deep sea gas in Tanzania;
- b. The potential gas market is too far to be accessed by pipeline;
- c. There is sufficient quantity of natural gas for LNG and other domestic application (approximately 38.6 TCF recoverable reserves by December 2015); and
- d. The political situation in the country encourages large-scale, long-term investments.

3.2.1.3 LNG Plant

According to Petroleum Act, 2015, a land based LNG facility has been decided against floating options. Given the current discoveries and demand forecast for other natural gas uses recommended in the Natural Gas Master Plan, two trains LNG plant with a capacity of 5 MTPA each has been used to forecast the demand and matched with the current reserves. This LNG plant size will consume 11.1 TCF for 20 years, which is equivalent to about 29% of the recoverable natural gas (38.6 TCF at 70% of the current GIIP). Alternative demand forecast for three and four trains LNG plants of the same size indicates that natural gas requirement will be 15.8 TCF and 19.5 TCF respectively for 20 years project life cycle.

3.2.1.4 LNG plant Investment costs

The average cost (Wood McKenzie, 2014) for recent world scale LNG projects is about US\$1.2 billion per MTPA, which translate to a total project cost of nearly US\$ 6 billion for a standard plant of 5MTPA. For an envisaged initial project of two trains in Tanzania, an investment of about US\$ 12 billion is foreseen. Construction which can only be undertaken by a few large specialized EPC contractors may take anywhere from 3 to 5 years to first shipment of LNG.

3.2.1.5 Traditional Pricing of LNG

LNG prices are typically expressed as US dollars per million BTU (US\$/MMBtu). This gives buyer's clear basis of understanding of prices in different markets. Japan is by far the largest importer of LNG in Asia, followed by China and South Korea. The price of LNG in Japan is the highest compared to other prices in the world and it is based on Japan Customs-cleared Crude (JCC). Japan price variation has been taken as a reference price for Tanzania LNG market in Asia.

The price of LNG has raised from US\$ 4.2/MMBtu in 2002 to US\$16.2/MMBtu in 2012 and then dropped to US\$ 10/MMBtu in 2015. Despite the lower price in Asia, this price is much higher compared to the Henry Hub prices in the Americas that ranged between US\$ 3 - 5/MMBtu in the same period with

little change due to the large amounts of shale gas being produced. The major risks may be flooding of market with LNG from other countries including Australia, United States of America, Mozambique, Middle East and others. However, there are prospects that the price will raise again in a near future. The estimated LNG prices as of June 2015 are indicated in Fig. 3.9 below.



Fig. 3.9. World LNG Estimated Landed Prices by June 2015 (Data in US\$/MMBtu)

Source: Waterborne Energy, Inc.

3.2.2 Pipeline Export Option

Transmission pipelines carry natural gas across long distances and occasionally across interstate boundaries, usually to and from compressors or to a distribution center or storage facility. Transmission lines are large steel pipes (usually 2" to 42" in diameter; most often more than 10" diameter) that are regulated. They carry gas at a pressure of between 13 bars to 90 bars. Natural gas transportation through pipeline is considered more economical for a distance less than 2000 km compared to LNG option. Examples of cross boarder natural gas pipelines include the Maghreb – Europe Gas pipeline (Algeria - Morocco – Spain 1620 km), Greenstream pipeline from Libya to Italy (540 km) and Mozambique to South Africa pipeline (865 km).

For the case of Tanzania, regional gas supply pipeline projects shall be considered to connect Tanzania with East Africa Community (EAC), Southern African Development Community (SADC) and

other African partner states. For the purpose of this plan, it is assumed that regional export is inevitable subject to detailed feasibility studies to determine the market and capacity of infrastructure required. Nevertheless, an amount of 400mmscfd, making a total of 3.1 TCF from 2025 to 2045 has been initially dedicated for export. Table 3.6 below provides a summary of natural gas demand projection for fuel use, feedstock and for export market.

Table 3.6. Summary of Gas Demand Projection (2016-2045)

	DOMESTIC DEMAND										EXPORT DEMAND		TOTAL	
USER	Electricity	Households	Institutions	CNGV	Industries	Petrochemicals					Iron & Steel	LNG	Pipeline	
						Fertilizer/ Ammonia	Methanol	GTL	DME	MTG				
Demand (TCF)	8.0	0.5	0.1	0.6	3.6	0.7	1.1	1.8	0.3	0.4	1.1	11.1	3.1	32.5
TOTAL (TCF)	18.3										14.2		32.5	

Source: IEEJ, 2015 and MEM, 2015

CHAPTER 4. GAS SUPPLY

Natural gas supply requires consideration of the magnitude and accessibility of the resource. Gas Initially in Place (GIIP) in Tanzania as of December, 2015 is 55.08TCF, out of which 47.08 TCF is offshore discovery and 8 TCF is onshore. Relatively small amount of the GIIP has been proven onshore, amounting to 1.169 TCF, which includes Songo Songo (880 BCF), Kiliwani (27 BCF) and Mnazi Bay (262 BCF). No reserve has yet been proven in the deep offshore. Onshore gas fields of Songo Songo and Mnazi Bay are already producing natural gas which is mainly used for electricity generation, as fuel for light industries, households and transport. More exploration activities are taking place to ensure increase of gas resources.

4.1 Exploration Activities

Tanzania has been exploring for oil and gas for the past 60 years since the early 1950s when BP drilled a number of wells along the coast of Tanzania mainland and on the islands of Zanzibar and Mafia. The first natural gas discovery was made in 1974 on the Songo Songo Island (Lindi Region) by AGIP (now ENI). However, in 1975, AGIP relinquished the Songo Songo natural gas field after declaring it non-commercial as the consumption and price of natural gas was not attractive worldwide. Later, TPDC undertook the development of the Songo Songo field by conducting several seismic survey programs and drilling five exploration wells. The drilling program confirmed the discovery in 1974. The present GIIP at the Songo Songo natural gas field is about 2.5 trillion cubic feet (TCF). However, proven reserve stands at 880 billion cubic feet (BCF).

In 1982, AGIP again discovered another gas field at Mnazi Bay in Mtwara Region. However, due to the small size of discovery and lack of a commercial gas market at that time, AGIP declared the field non-commercial where they plugged well and relinquished the concession. Later, assessment under TPDC and Artumas Group (now under Wentworth Resources) established resources of gas initially in place (GIIP) of about 5.0 TCF. The proven reserve stands at 262 BCF.

In addition to Songo Songo and Mnazi Bay gas fields, other new shallow water (less than 200m water depth) and onshore discoveries include Mkuranga in Coast Region (2007) - 200 BCF; Kiliwani in Lindi Region (2008) - 70 BCF and Ntorya in Mtwara Region (2012) - 178 BCF. The total natural gas discovered in shallow water and onshore (GIIP) is estimated at 8.0 TCF. On other hand, the deep sea (water depth equal to or greater than 200 metres) discoveries have brought about new exploration targets for hydrocarbons in Tanzania territorial waters. As of December 2015, about 47.08 TCF has been discovered on deep sea exploration at an average water depth of 1,500m and more than 100km

from the shore. This brings the total natural gas initially in place, for both onshore and offshore Tanzania's basins, to about 55.08 TCF. Further exploration and appraisal is going on and the expectations are that more gas resources, and may be oil, can be discovered.

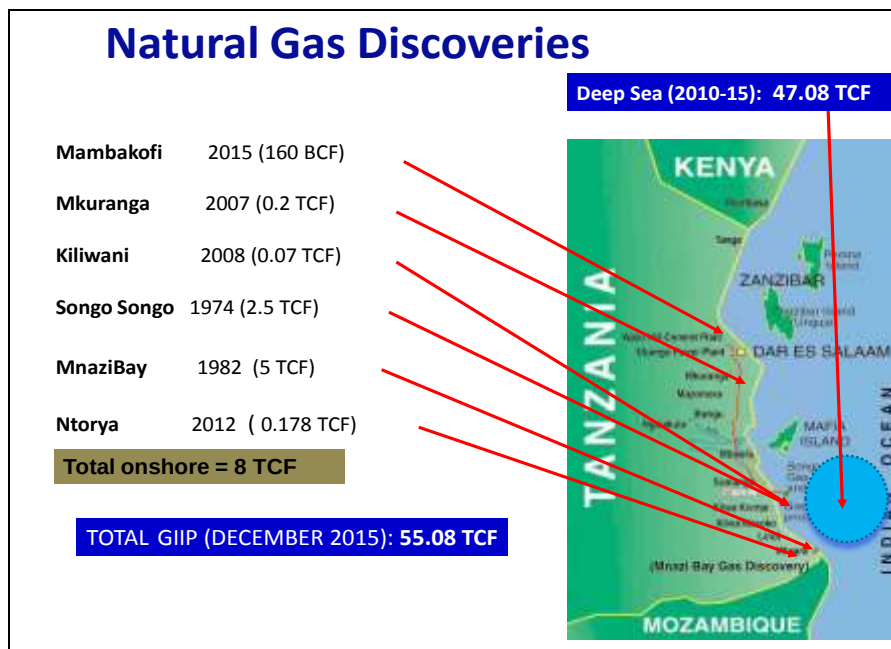


Fig.4.1: Natural Gas Resources in Tanzania

Source: TPDC, 2015

4.1.1 Natural Gas Production and Existing Infrastructure

Two onshore fields, namely Songo Songo and Mnazi Bay, are currently producing natural gas. An average of 33 BCF of natural gas is produced annually, of which 80 percent is used for power generation and 20 percent in industries, households, commercial buildings, public institutions and transportation.

4.1.1.1 Songo Songo Natural Gas Field

Production at Songo Songo field commenced in 2004 when a natural gas processing plant with a design capacity of 70 MMscfd and a 16" gas transportation pipeline with a maximum deliverability of 105 MMscfd from Songo Songo Island to Dar es Salaam were commissioned. However, following a surge in demand for natural gas for electricity generation and industrial uses, the capacity of the processing was related to 110 MMscfd in 2008. Currently production at Songo Songo is about 100 MMscfd.

4.1.1.2 Mnazi Bay Natural Gas Field

Production at Mnazi Bay natural gas field commenced in 2006, around 24 years from its first discovery. The present capacity of the gas processing system is 10 MMscfd, which can be expandable to 25 MMscfd. However, due to lack of established market in Lindi and Mtwara Regions and limited infrastructures to other potential markets, the current production is between 1.8 to 2.0 MMscfd supplied only to Mtwara power generation plant owned by TANESCO.

4.1.2 New infrastructure

The Government through TPDChas constructed new natural gas infrastructure including two processing plants, one located at Madimba (Mtwara) and the second located at Songo Songo Island (Lindi). The processing plant located at Songo Songo Island consists of two trains with capacity to process 140 MMscfd while that at Madimba Mtwara consists of three trains with a capacity of 210 MMscfd, without compression. Each of the two processing plants has been designed for future expansion by adding trains once demand of natural gas increases.

Further, the infrastructure includes a 36 inch 487 km pipeline from Madimba via Somanga Fungu to Kinyerezi in Dar es Salaam, a 24 inch 25 km marine pipeline from Songo Songo Island to Somanga Fungu and a 16 inch 30 km pipeline from Kinyerezi to Tegeta. The capacity of the main (36 inch) pipeline is rated at 784 MMscfd but can handle up to 1002 MMscfd with compression. The project was completed in October, 2015.

4.1.3 Concluding Remarks

Tanzania remains under explored with several potential exploration basins with a high probability of oil and gas discoveries. Also, within the blocks adjacent to the discovery blocks, the probability of more gas discoveries is very high. To facilitate further discoveries, more efforts are needed to promote exploration activities. Correspondingly, development of the existing gas reserves should be given priority together with the development of infrastructure to supply natural gas to the market. Currently, the proven natural gas amounts to 1.169 TCF whereas GIIP is 55.08. Therefore, more efforts are needed from gas developers to appraise and confirm recoverable reserves in line with the growth in demand.

CHAPTER 5. GAS SUPPLY AND DEMAND BALANCE

Analysis of Demand and Supply balance is based on the recoverable reserves, plans to develop the discovered reserves and forecasted demand. Plans to develop the discovered reserves are based on the assumption that 70% of the GIIP will be recovered. In this case, taking the GIIP of 55.08TCF as of July 2015, the recoverable reserves are estimated at 38.6TCF. Plans to develop the discovered reserves include strategy to supply gas to the domestic market and development of LNG project.

In addition to the supply scenario discussed in chapter three, a high case demand scenario is introduced against the recoverable reserves to explore more possibilities of balancing demand against supply of the natural gas. For high case scenario, different assumptions are made on demand growth factors over years and the number of LNG trains, ranging from two to four trains. Basing on the scenarios as presented in Table 5.1, for the base case, the available recoverable reserves can suffice the projected domestic natural gas demand with two or three LNG trains for 30 years.. However, for the high case, only two train's scenario can be satisfied in parallel with the projected domestic natural gas demand if no further discoveries are made before 2045. Two LNG trains base case shows that by 2045, the current reserves will be consumed by 86%, and the remaining reserves can last for the next three years.

For the purpose of balancing demand and supply, it is prudent to consider two LNG trains case, which reasonably ensure availability of natural gas for domestic projects and for export market while making the use of natural gas in the country sustainable. It is anticipated that development of natural gas fields will increase the availability of more gas to meet domestic demand as well as export market. This will also trigger discovery of new reserves to cater for the increasing demand.

Table 5.1: Demand Scenario vs Discovered Reserves

	Base Case			High Case		
<i>Scenario</i>	<i>Domestic + 2Trains</i>	<i>Domestic + 3Trains</i>	<i>Domestic + 4Trains</i>	<i>Domestic + 2Trains</i>	<i>Domestic + 3Trains</i>	<i>Domestic + 4Trains</i>
Consumption	TCF	TCF	TCF	TCF	TCF	TCF
2015→35	16.0	18.0	18.9	17.1	19.1	20.0
2015→45	33.3	38.1	41.7	35.4	40.1	43.8
Against 38.6Tcf	86%	99%	108%	92%	104%	114%
R/P - Yrs (2045)	2.64	0.24	(1.59)	1.51	(0.74)	(2.46)

Source: IEEJ, 2015 and MEM, 2015

According to this master plan, the first offshore gas is expected on stream by 2025. Before this period, the existing demand will be supplied with the natural gas from the onshore gas fields as elaborated in table 5.2 and Table 5.3. Thereafter, the projected demand will be supplied with the natural gas from onshore and offshore fields.

Table 5.2: Recoverable Natural Gas as of December 2015

GIIP as of December 2015		Recoverable rate at 70%	
Source	Volume (TCF)	Source	Volume (TCF)
Onshore fields	8	Onshore fields	5.60
Offshore fields	47.08	Offshore fields	32.96
Total GIIP	55.08	Total Recoverable	48.56

Source: TPDC, 2015

Table 5.3: Natural Gas Demand vs Supply Source and reserve balance

Duration (Years)	Demand (TCF)	Supply		Recoverable Reserve Balance	
		Source	Volume (TCF)	Source	Volume (TCF)
2016 - 2025	3.16	Onshore	3.16	Onshore	2.44
		Offshore	-	Offshore	32.96
		Total Supply	3.16	Total Recoverable	35.40
2026 - 2035	12.84	Onshore	2.44	Onshore	-
		Offshore	10.40	Offshore	22.56
		Total Supply	12.84	Total Recoverable	22.56
2036 - 2045	17.31	Onshore	-	Onshore	-
		Offshore	17.31	Offshore	5.24
		Total Supply	17.31	Total Recoverable	5.24

Source: Ministry of Energy and Minerals, 2015

Table 5.3 above has considered a two LNG trains scenario, which shows that by the end of this plan period, if there are no further discoveries of natural gas, the recoverable reserve balance will be at 5.24 TCF.

As depicted in Table 5.1 and Table 5.3, since the existing reserves cover the projected demand over the planned period (up to 2045), it is important to promote development of discovered reserves and investment in the infrastructure to deliver natural gas to the identified market.

CHAPTER 6. INFRASTRUCTURE DEVELOPMENT AND GAS SUPPLY COSTS

The cost for infrastructure development and supply of natural gas to the end user requires thorough analysis of multiple parameters including supply options which, for the purpose of this Master Plan require detailed studies. Knowing the gas supply cost is essential to the planning of realistic sector financing. All players in the natural gas industry as indicated in Fig. 6.1 must be considered in the analysis.

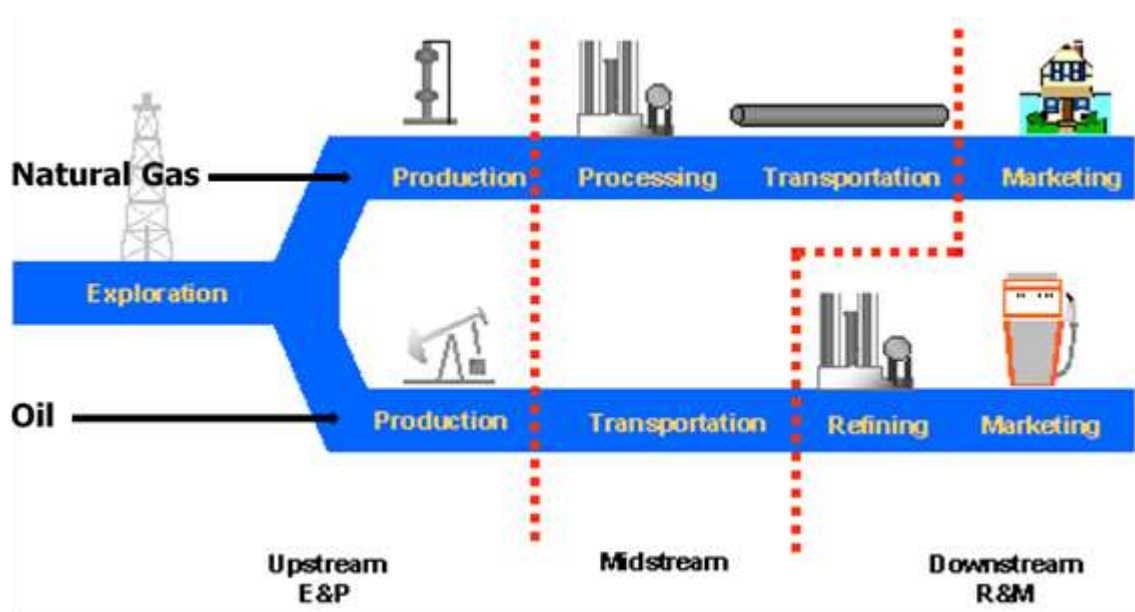


Fig. 6.1: Oil and Natural Gas Supply Chain (need to replace the word 'crude oil')

Source: PetroStrategies, Inc

Determination of supply cost will include upstream costs (exploration, development and production), midstream costs (processing and transportation) and downstream costs (distribution and connection to end users).

6.1.1 Processing Facilities

Natural gas from production wells contains impurities such as condensate, hydrogen sulphide, Carbon dioxide and water that need to be removed before the intended use. Investment in the processing facilities will be required as demand for both local and regional market grows. The existing processing infrastructure has a capacity of 420 mmscfd with possible expansion, based on the existing pipeline capacities, to 850 mmscfd without compression. Based on the demand studies, it is projected that this

processing capacity can satisfy the demand up to 2035. This means future investment in processing facilities will definitely be required before 2045.

6.1.2 Local and Regional Transportation

6.1.2.1 Transportation pipelines

Considering that the market for natural gas is scattered throughout the country and beyond, investments into local and regional transmission pipelines routes are proposed arbitrarily to be done in phases of five years period. The tentative phasing proposed in NGUMP include Phase 1 that will cover the transmission pipeline to run from Dar es Salaam to Mwanza, from Dar es Salaam to Arusha and from Mtwara to Njombe. The Second Phase will be construction of a transmission pipeline from Morogoro to Mbeya, while the third Phase will connect Mbeya to Sumbawanga, Tabora to Kigoma, Mwanza to Kagera and Mwanza to Mara regions. The tentative routing is as proposed in Fig. 6.2 below. However, the actual routing could be determined through detailed feasibility studies including export options in the region.

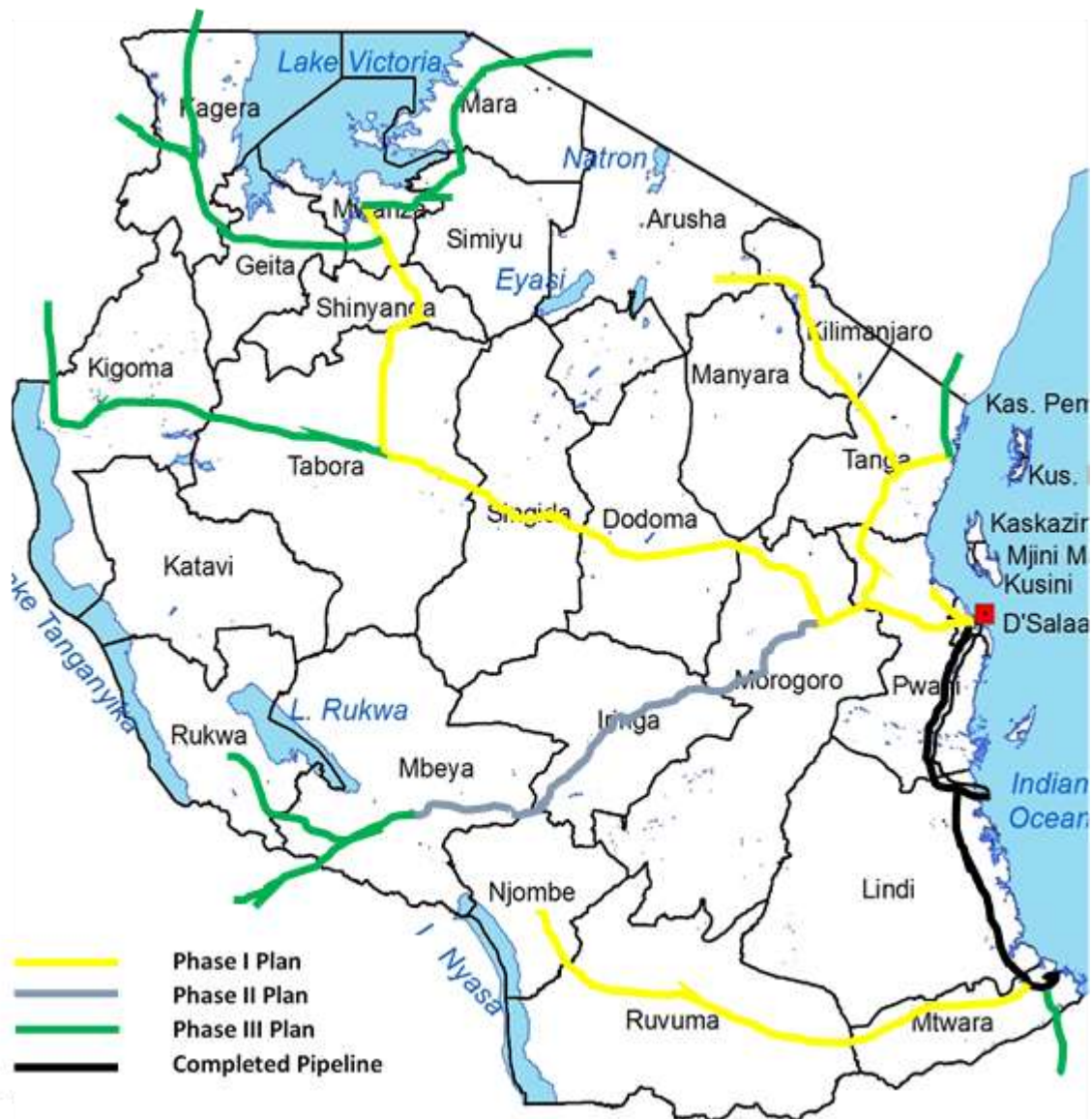


Fig. 6.2: Map of proposed Future Plans for Natural Gas Pipeline Construction

6.1.2.2 LNG Tank Truck Supply

Although the main method for natural gas transportation all over the world is through pipeline, there are some remote areas where the expensive pipeline investment is uneconomical due to the demand side and the distance to the point of consumption. As an alternative means of transportation for these areas, natural gas can be moved in liquid form (LNG) by tank trucks to secondary terminal called satellite station, where LNG is re-gasified for supply via piping services. Alternatively, LNG satellite system can be supplied with natural gas through railway tank containers and marine vessels. Project economics will determine the selection of the means of natural gas transportation.

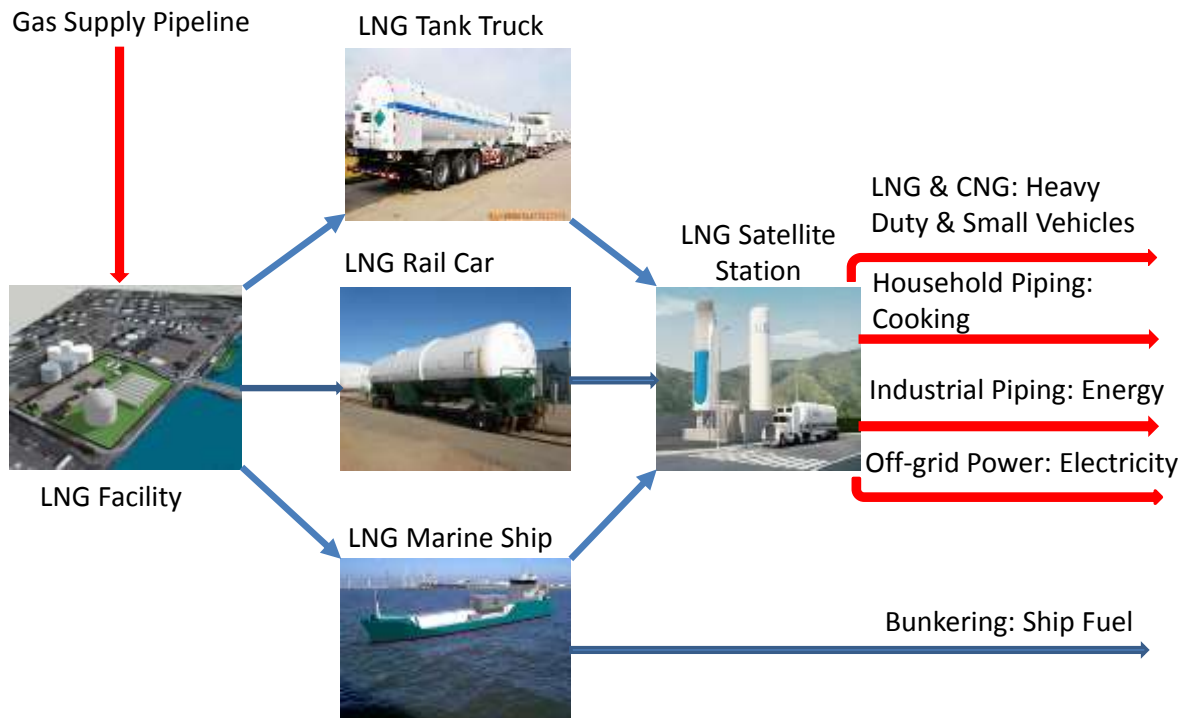


Fig. 6.3: LNG satellite supply options

6.2 Upstream Costing

This part presents essential investment cost basis for the natural gas field to be developed to serve export and domestic market. The analysis should be based on the recoverable natural gas reserve of 38.6 TCF comprising 33 TCF and 5.6 TCF from offshore and onshore resources respectively (by July 2015). The upstream costs should be determined during the negotiation by the parties and verified by the upstream regulator, PURA.

6.2.1 Midstream Costing

In accordance with Petroleum Act 2015, all activities related to midstream investment are subject to regulation. Mid-stream costing analyzes essential investment costs needed for the gas to be processed and transported to serve both domestic and export markets. The critical investments that have to be incurred may include construction of processing, liquefaction, regasification and storage facilities together with transportation pipelines.

6.3 Other Supporting Infrastructures

In order for NGUMP to be realized, other auxiliary infrastructure development will be required to support the oil and gas related industry. Efficient ports services to facilitate materials and equipment importation as well as exporting finished goods will be paramount. On other hand, robust road and railway networks as well as airports will be needed not only for enabling efficient movement of goods emanating from projects highlighted by the NGUMP, but also to create favourable environment for movement of people who will be employed by those projects.

6.4 Concluding remarks

The implementation of the above infrastructure will depend on the economic viability of the projects. However, in other areas where there are other alternative sources of energy such as coal, preference will be given to the available source.

CHAPTER 7. PREREQUISITES FOR DEVELOPMENT OF DOMESTIC PROJECTS

Following the establishment of NGUMP, the Government has specific considerations to be used in undertaking domestic projects. The specific considerations include:-

7.1 Pricing for Domestic Gas

To ensure sustainability of the sector, a proper pricing regime that balances the public and investors interests is required. Natural gas pricing methodology should encourage use of natural gas for domestic use including power generation, industries, transportation and cooking. The pricing regime must ensure that the price reflects efficient business operations, allowing for a fair return on investment and ensuring a price stability in order to promote efficient consumption of natural gas in the economy; and encourage further investment to satisfy future demand.

Different methods of natural gas pricing should be adopted depending on the use of natural gas. Cost reflective price should be charged to the strategic users such as power generation and fertilizer manufacturing while alternative fuel price methodology should be used for industries and domestic use. However, alternative fuel pricing methodology should have a price seal to ensure that natural gas price reflects investment costs incurred in the natural gas value chain.

7.2 Gas Allocation

Discovery of significant amounts of natural gas in Tanzania is attractive to mega-project promoters. Implementation of mega-projects bears great potential to generate significant tax revenues, in addition to improving viability of capital intensive projects of natural gas transportation and distribution pipelines and other gas infrastructure in areas far from gas discovery sites, as it is not always possible for SMEs to justify such huge investments. Once the infrastructure is established, depending on the mega-project economics, the SMEs will benefit from the availability of gas. Table 7.1 provides strategic projects by industrial sectors that can be implemented under this master plan, based on the current knowledge of the natural gas resource, volume of natural gas required and timing of each project.

Table 7.1: Timing and gas volumes (BCF per year) allocation for strategic project

Year	Electricity	Households	Institutions	CNGV	Industries	Fertilizer/ Ammonia	Methanol	GTL	DME	MGT	Iron and Steel	LNG	Regional Pipeline	Total	Cumulative Total
2016	52	12.6	3.6	6.9	76.4									151.4	151.4
2017	59	12.9	3.6	7.3	78.6									161.3	312.7
2018	94	13.1	3.7	7.8	81.0									199.8	512.5
2019	101	13.4	3.8	8.2	83.4									209.8	722.3
2020	107	13.7	3.9	8.7	85.9	18.5								237.5	959.8
2021	115	13.9	3.9	9.3	88.5	22.4								252.6	1,212.4
2022	123	14.2	4.0	9.8	91.2	26.4								268.6	1,481.0
2023	132	14.5	4.1	10.4	93.9	26.4	23.1		8.3	14.3	49.5			376.8	1,857.8
2024	143	14.7	4.2	11.1	96.7	26.4	26.4		8.9	15.3	49.5			395.9	2,253.7
2025	154	15.0	4.3	11.7	99.6	26.4	29.7		9.5	16.3	49.5	288.6	146.0	851.0	3,104.7
2026	166	15.3	4.4	12.5	102.6	26.4	33.0		10.1	17.3	49.5	439.8	146.0	1,023.0	4,127.6
2027	179	15.6	4.4	13.2	105.7	26.4	33.0	35.4	10.7	18.4	49.5	495.1	146.0	1,132.4	5,260.0
2028	193	15.9	4.5	14.0	108.9	26.4	33.0	44.2	11.3	19.4	49.5	549.8	146.0	1,216.0	6,476.0
2029	209	16.2	4.6	14.9	112.1	26.4	33.0	44.2	11.9	20.4	49.5	549.8	146.0	1,237.6	7,713.7
2030	226	16.6	4.7	15.8	115.5	26.4	33.0	44.2	11.9	20.4	49.5	549.8	146.0	1,259.3	8,972.9
2031	244	16.9	4.8	16.7	119.0	26.4	33.0	44.2	11.9	20.4	49.5	549.8	146.0	1,282.7	10,255.6
2032	264	17.2	4.9	17.8	122.5	26.4	33.0	70.8	11.9	20.4	49.5	549.8	146.0	1,334.6	11,590.2
2033	287	17.5	5.0	18.9	126.2	26.4	52.8	88.4	11.9	20.4	49.5	549.8	146.0	1,399.5	12,989.7
2034	311	17.9	5.1	20.0	130.0	26.4	59.4	88.4	11.9	20.4	49.5	549.8	146.0	1,435.8	14,425.5
2035	338	18.2	5.2	21.2	133.9	26.4	59.4	88.4	11.9	20.4	49.5	549.8	146.0	1,468.0	15,893.5
2036	365	18.6	5.3	22.5	137.9	26.4	66.0	88.4	11.9	20.4	49.5	549.8	146.0	1,507.4	17,400.8
2037	394	19.0	5.4	23.9	142.0	26.4	66.0	106.1	11.9	20.4	49.5	549.8	146.0	1,560.3	18,961.2
2038	426	19.3	5.5	25.3	146.3	26.4	66.0	132.7	11.9	20.4	49.5	549.8	146.0	1,624.9	20,586.1
2039	460	19.7	5.6	26.9	150.7	26.4	66.0	132.7	11.9	20.4	49.5	549.8	146.0	1,666.0	22,252.1
2040	498	20.1	5.7	28.5	155.2	26.4	66.0	132.7	11.9	20.4	49.5	549.8	146.0	1,710.3	23,962.4
2041	539	20.5	5.9	30.3	159.9	26.4	66.0	132.7	11.9	20.4	49.5	549.8	146.0	1,758.0	25,720.4
2042	583	20.9	6.0	32.1	164.7	26.4	66.0	132.7	11.9	20.4	49.5	549.8	146.0	1,809.6	27,530.0
2043	632	21.3	6.1	34.1	169.6	26.4	66.0	132.7	11.9	20.4	49.5	549.8	146.0	1,865.3	29,395.3
2044	684	21.7	6.2	36.2	174.7	26.4	66.0	132.7	11.9	20.4	49.5	549.8	146.0	1,925.4	31,320.7
2045	741	22.1	6.3	38.4	179.9	26.4	66.0	132.7	11.9	20.4	49.5	549.8	146.0	1,990.3	33,311.0
TOTAL (BCF)	8,816	509	145	554	3,633	675	1,142	1,804	261	448	1,139	11,120	3,066	33,311.0	

Source: IEEJ, 2015 and MEM, 2015

The legal framework should provide for licensing procedures for the development of mega-projects, based on a transparent qualification process and in strict observance of all relevant Tanzanian laws.

7.3 Projects Qualification

Each project submitted shall be evaluated and ranked in quantitative and qualitative merits using, among others, the criteria presented below:

- a) **Project Priorities:** Projects that add values of natural gas such as electricity generation, fertilizer, gas-to-liquids (GTL), methanol and other sub-products, will have a higher priority over others. However, this prioritization should be seen as a general guideline, as market conditions may change over time. Thus, this criterion does not intend to deter promoters of projects that may add more values than earlier envisaged.
- b) **Gas Price:** Bidders must submit a price for the gas that they are willing to buy. This price should cover the upstream, midstream and downstream costs. A mega-project that requests a greater price of gas will receive a higher rating, once other elements are weighed, including the project's impact on the national economy.
- c) **Quantity of Gas Requested by the Developer:** The volume of gas should be sufficient either by itself or in combination with other developers to support the construction of a pipeline to the proposed facilities. The developer will need to justify the economics for the pipeline connection and propose a plan for its construction. A mega-project with large gas volume request and with economically consistent plans for pipeline development will be ranked higher. Project developers can coordinate with each other and also propose public-private partnerships for pipeline development.
- d) **Timeframe for Project Development:** Priority will be given to those projects that can be implemented and come into operation as soon as natural gas is made available.. Project developers are required to submit a timeframe for construction and operation of the project, along with a list of required permits and planned timeframe for obtaining them. They need to provide a list of potential risks for delays and a risk management plan intended to ensure timely construction and operation.
- e) **Location of the Mega-Projects:** Mega-projects should be located at strategically selected locations to facilitate common use of facilities and eliminated duplication of investment to earn a competing edge in the global market. Developers proposing projects within strategically selected location will be ranked higher, as long as they can justify their economics. The

Government may recommend other potential locations for consideration by prospective developers.

- f) **Technical and Financial Viability of the Project:** All proposals will be evaluated on the merits of their technical and commercial viability. Project developers will be required to demonstrate the technical qualifications, including prior experience, and the specific engineering and technical plans for the proposed mega-project. Developers will also be required to demonstrate that they have the financial resources to undertake the investment in Tanzania, to demonstrate their creditworthiness. Developers will also provide the commercial basis for their project.
- g) **Developer's Commitment to Employ Tanzanians:** All mega-project proposals should have action plans for employing Tanzanian citizens. Such plans should include a description of how the mega-project proposes to increase Tanzanians in skilled labour categories over time. Project developers must submit the employment plans in compliancy with Petroleum Act 2015.
- h) **Developer's Commitment to Engage Local Suppliers of Goods and Services:** Developers must have action plans showing how they will engage existing SME's to provide them with goods and services. They may also draw attention to the need to develop SMEs that do not yet exist in Tanzania, and propose ways in which the Government could support such SMEs in the supply chain. Project proposals that undertake to engage large number of Tanzanian suppliers will receive a higher rating. Proposals that offer realistic action plans and make recommendations to the Government will receive a higher rating.
- i) **Developer's Commitment to Mitigate Social and Environmental Impacts:** The Government intends to minimize the negative impacts of development projects in local communities and the environment. Therefore, project developers should indicate how should conduct the necessary environmental studies, in accordance to the existing laws, and commit to implement the necessary mitigation measures, as well as environmental management plans as per Environment Management Act (EMA) 2004.
- j) **Corporate Social Responsibility and Empowerment:** Project developers need to provide initial plans for the kinds of credible activities that they will undertake as part of their corporate social responsibility, taking into account local community priorities. Proposals that have realistic and reasonable plans for promoting social benefits to the local community will be ranked higher.

- k) **Benefits to Tanzanians:** Developer proposals must demonstrate how their projects will benefit Tanzanians broadly. Benefits may include additions to employment, education, tax revenues, infrastructure development, and environmental enhancements. Proposals that include both quantitative and qualitative list of benefits will be ranked higher.
- l) **Local Participation:** Proposals shall bear in its capital structure, an initial local participation of at least 15% that should increase over time through the placement of shares on the Dar es Salaam Stock Exchange (DSE). This interest should be ring fenced for Tanzanian market. Project registering high share in DSE will be ranked higher.

The classification of projects as described in criteria above will be used to decide which project proposals are eligible for consideration. The Government will ensure that all companies adhere to the same rules, and that the criteria outlined above will be evaluated fairly, consistently and transparently.

7.4 Financial and Fiscal Management

The improvement of macro-economic and fiscal policies is a major priority for the Government of Tanzania, in order to contribute to the opportunities presented by the development of natural gas. The Government recognizes the need to improve the quality, effectiveness and efficiency of public services, and adopting policies that minimize the macro-economic distortions and the competitiveness of the economy, while promoting a more inclusive and horizontal economic growth.

The Government will continue to implement the necessary institutional reforms that aim to support the increase of revenue streams, fiscal management and an effective public investment decision-making process; capacity building; develop policies and mechanisms to mitigate the effects of price volatility of raw materials in the domestic economy; mitigate the impacts of rising real effective exchange rate; develop fiscal and monetary policies to encourage savings for future investments, and develop policies for revenue sharing; in order to distribute wealth and the balanced economic growth through various geographical regions.

7.5 Financing Strategies for Projects

The primary projects which include upstream investment will be financed through PSA partners while secondary projects which include midstream and downstream projects will be financed either through Government, Public Private Partnership or purely private funding.

7.6 Capacity Building and Local Content

National capacity building is an essential ingredient in enabling Tanzanians to participate in and benefit from natural gas activities. Natural gas development projects will undoubtedly need significant diversity of professions. Notwithstanding the requirement of industry at large, the Government will also need new competences from existing and new institutions for designing and executing administrative and regulatory measures in addition to direct participation in development of natural gas projects. Competence will also be needed in Non- Governmental institutions such as Civil Society Organizations (CSOs) for creating awareness and understanding of the benefits of natural gas projects to the country's economy. A continued development of gas-related competences is of crucial importance to support the implementation of NGUMP.

Whilst encouraging immediate recruitment and development of indigenous skills, in the short and medium term, a balance must be struck between that goal and the required expertise to successfully operate the sector. For this respect, the Government may procure expert consultancies and contractors to help deliver specific tasks of immediate need before the capacity of local Tanzanian is developed. In the long term, Tanzanians will acquire enough expertise and knowledge on existing practices in the existing gas industries in other countries and through working with experienced consultants and contractors. Likewise, local providers for goods and services shall strive to strengthen their capacities to serve the entire natural gas value chain. Specific strategies have to be adopted to promote and guarantee local content.

7.7 Corporate Social Responsibility and Empowerment

Corporate Social Responsibility and Empowerment (CSRE) refer to the commitment by the business to share benefits arising from the business with the community in which it operates. CSRE is instrumental in developing and maintaining sound and trust worth relations between business and the community. The companies implementing projects and activities in the natural gas industry are therefore expected to contribute positively to the development process of the local communities through respective Local Government Authorities preferably involving village government, focusing their CSRE activities to address the most pressing needs of the surrounding communities.

CHAPTER 8. LEGAL AND REGULATORY FRAMEWORK

8.1 Policies

To enhance energy security, mitigate climate change, generate income and create employment, energy resources have to be explored in a diversified manner. Tanzania is endowed with abundant energy resources including natural gas, hydro, coal, uranium, and renewable energies. To exploit these resources efficiently and sustainably, the energy sector requires robust legal and regulatory framework as well as sound institutional set up. The Government of Tanzania through the Ministry of Energy and Minerals put in place policies, instruments and strategies to guide and promote the development and sustainable use of energy resources of the country as follows

National Energy Policy 2015 The National Energy Policy, 2003 played an important role in guiding the development in the energy sector. One of its aims was to align itself with the overall macro-economic policy objectives and promote private sector participation in the sector. Several achievements were registered during implementation of this policy including establishment of Rural Energy Agency (REA), Energy and Water Utilities Regulatory Authority (EWURA) and Power Sector Reform. Despite achievements, the sector still face a number of challenges which include: increasing access to modern energies, ensuring security of supply, reducing the cost of supply, environmental protection, research and development of appropriate energy technologies, increasing private sector participation in the energy sector, expanding energy sector infrastructure, raising necessary financing for energy projects and the management of the Petroleum subsector.

Recognizing the challenges in the National Energy Policy 2003 which moves concurrently with the growth of energy sub-sector such as natural gas discoveries and transformation of the economy, the Government formulated National Energy Policy, 2015, that reflects the vision of the Government and the society in transforming the economy. Special attention being given to the overall structure and mechanisms of the economy, the socio-economic development ambitions, national priorities, and prudent use of scarce national resources. The National Energy Policy 2015 addresses directly the challenges in the petroleum sub-sector management, natural gas development and the local content issues in the energy sector as follows:-

8.1.1.1 Petroleum Upstream Sub-Sector Management

The challenges in managing the petroleum sub-sector have been compounded by: increased petroleum exploration activities in the country; recent natural gas discoveries in the deep waters; and increased

interest of multinational petroleum exploration companies in the country. The increased petroleum operations particularly in the offshore areas call for the establishment of robust guidelines to mitigate negative impacts that may occur within i.e. Health, Safety, Security and Environment Management. The main objective is to explore, produce and utilize the country's petroleum resources in an effective and efficient manner that ensures lasting benefit to the nation as well as minimizing negative impacts to the society and environment.

8.1.1.2 Natural Gas Development

The Policy provides guidelines for the development of the natural gas industry in order to ensure optimal benefits to Tanzanians and the national economy in the short, medium and long term. Maximization of the benefits will be attained through the optimization of the value chain which consists of mid-and down-stream activities. The main objective of the Policy is to provide guidance for the sustainable development and utilization of the natural gas resource and maximization of the benefits there from and contribute to the transformation and diversification of the Tanzanian economy.

8.1.1.3 Local Content in the Oil and Gas Industry

Based on the rapid growth in oil and gas industry, the exploration activities in large part of the country, discovery of remarkable amount of natural gas both on and off – shore are anticipated to significantly contribute to the socio – economic development of the country and certainly raise the living standard of Tanzanians. For Tanzania to attain middle income status by 2025, it has to increase its GDP per capita of about US\$ 630 in 2014 to around US\$ 3000 in 2025. This can be achieved by, among others, rationalizing the exploitation of its oil and gas industry resource and increased local participation in the value chain. The intention of the Policy is to provide the guiding principles for maximum engagement of local content and local participation in the development of the oil and gas industry to ensure optimal benefits to Tanzanians.

8.1.2 National Forest Policy, 1998

Woodfuel is the main source of energy for most Tanzanians. That, about 90% of the total energy used in Tanzania is from wood. Woodfuel, especially charcoal, is also an important source of livelihood for rural and urban communities. Woodfuel consumption will continue to increase with increasing population due to unavailability of appropriate alternative affordable sources of energy. Lack of affordable alternative sources of energy has contributed to the degradation of natural forests due to practically uncontrolled harvesting of woodfuel. Generally, efficient wood conversion technology and

methods are unaffordable therefore alternative sources of energy such as natural gas for domestic use should be promoted in order to overcome the deficiency and deforestation burden.

8.1.3 Cross Cutting Policies and Strategies

In addition to the existence of the above policies in the management and development of the natural gas sector, other complementary policies and strategies are in place in diversifying natural gas use in the country. These include; the Sustainable Industrial Development Policy, 1996; Integrated Industrial Development Strategy 2025 of 2011; National Environmental Policy, 1997 (currently under review); Investment Policy, 1996 and the National Health Policy, 2003.

8.2 Institutional Framework

Successful implementation of any development policy depends on institutional framework set in place in developing tools for operationalization, enforcement, monitoring and evaluations in order to attain the intended goals. The institutional framework articulates major roles of key institutions directed towards a transformed economy and sustainable growth and development.

8.2.1 Ministry of Energy and Minerals

The Ministry of Energy and Minerals on behalf of the Government is responsible for promoting development and efficient utilization of natural gas in Tanzania. The Ministry manages petroleum resources and its operations for the benefit of the country, in compliance with the laws, policies and existing contractual commitments. Under this framework, the role of the Ministry is to:

- a) Establish legal and regulatory framework which govern the processing, transportation, liquefaction, distribution, supply and trading of natural gas to ensure efficient management, expedite development of mid- and down-stream activities to maximize benefits accrued from natural gas resource;
- b) Establish proper mechanisms to provide reliable and affordable supply to domestic market;
- c) Ensure that the regulatory authorities for natural gas industry are strengthened;
- d) Ensure compliance with generally accepted international standards for natural gas industry; and
- e) Ensure stable, robust and sound legal framework for natural gas industry.

8.2.2 National Oil Company (NOC)

In the new Institutional Framework for the oil and gas subsector, TPDC has been designated as the National Oil Company (NOC) and shall manage Tanzania commercial aspect of petroleum activities and participating interest of the Government in the petroleum and natural gas agreements. NOC has exclusive rights over all natural gas upstream, midstream, and downstream value chain activities as stipulated in the Petroleum Act 2015, Section 9 (2). It may form subsidiaries to carry out specific petroleum operations or related activities.

8.2.3 Petroleum Upstream Regulatory Authority (PURA)

The Authority to regulate and monitor petroleum upstream activities is PURA. It is an independent Authority in the performance of its functions and exercise of its powers. The Authority has responsibilities of advising the Minister for Energy and Minerals on promotion and bidding process, negotiation of production sharing agreement and licensing matters. It shall advise the Government on proposed fields development plans, infrastructure development, tail end plans and decommissioning of installations submitted by the license holders.

PURA shall perform its functions as stipulated in the Petroleum Act 2015, Section 12 (1) and (2).

8.2.4 Energy Water Utility Regulatory Authority (EWURA);

The Energy and Water Utilities Regulatory Authority established under the Energy and Water Utilities Regulatory Authority Act 2001 Cap 414, shall exercise regulatory powers in respect to midstream and downstream petroleum and natural gas activities.

EWURA shall perform its functions as stipulated in the Petroleum Act 2015, Section 30 (1) and (2).

8.2.5 Other Key Institutions

To accomplish these obligations, the following institutions will be responsible for natural gas management and development: President's Office Regional Administration, Local Government, Civil Service and Good Governance; President's Office, Planning Commission (POPC); Vice-President Office Union Affairs and Environment; Prime Minister's Office Policy, Parliamentary Affairs, Labour, Employment, Youth and the Disabled; Ministry of Finance and Planning (MoFP); Ministry of Education, Science, Technology and Vocational Training; Ministry of Industry, Trade and Investment (MITI); Ministry of Land, Housing and Human Settlement (MLHHS); Ministry of Home Affairs (MHA); Ministry of Agriculture, Livestock and Fisheries (MALF); Ministry of Works, Transport and Communication; Ministry

of Foreign Affairs, E.A.C., Regional and International Cooperation; and Ministry of Health, Community Development, Gender, Elderly and Children.

Other institutions include the National Environmental Management Council (NEMC); Occupational Safety Health Authority (OSHA), Tanzania Bureau of Standard (TBS); Weight and Measures Agency (WMA); Tanzania Revenue Authority (TRA); Central Bank of Tanzania (BoT), Private Sectors through Tanzania Private Sector Foundation (TPFS), Academic and Research Institutions, Media, Civil Societies and Communities.

8.3 Legal and Regulatory Framework

Legal and Regulatory Framework for upstream, midstream and downstream activities, among others, comprise of licensing, tariff structure, rates and charges, quality and standards, health and safety issues, third part access to common infrastructure and services, revenue management and related aspects of natural gas industry administration and regulation.

The current legal framework for natural gas management and development is governed by various Acts of Parliament, including: The Constitution; Petroleum Act, 2015; the Energy and Water Utilities Regulatory Authority Act, 2001(Cap. 414); Income Tax Act, 2008 (Cap. 332); Environmental Management Act, 2004; the Local Government (District Authorities) Act, 1982 (Cap. 287 R.E. 2002); the Land Act, 2004 (Cap 113 R.E. 2002); Public Procurement Act, 2011; the Public Private Partnership Act, 2014; Occupational, Safety and Health Act, 2003; Investment Act, 1997; and the Employment and Labour Relations Act, 2004 (Cap. 366), Oil and Gas Revenue Management Act, 2015.

CHAPTER 9. MONITORING AND EVALUATION

Monitoring and evaluation means a systematic collection, analysis and comparison between the actual progress of activities and objectives previously formulated under a specific project. Monitoring the implementation of Natural Gas Utilization Master Plan (NGUMP) is necessary to ensure that projects are implemented as planned and timely, hence ensure a balanced scenario between supply and demand of natural gas both for domestic and international markets. Hence coordination and monitoring of activities in the gas sector is inevitable. In the natural gas industry, monitoring and evaluation and reporting on regular basis is important in the following areas:

- a) Implementation of the National Energy Policy 2015;
- b) development stages of upstream and downstream activities;
- c) construction of natural gas mega-projects;
- d) environmental and social impacts assessments;
- e) safety and health in the natural gas related projects;
- f) Tanzanians involvement (local content) along the natural gas value chain; and
- g) Rate of replacement of indigenous energy by natural gas.

In order to achieve effective monitoring and evaluation of activities in the natural gas industry, the Ministry of Energy and Minerals shall undertake overall responsibility for monitoring and evaluation of the implementation activities identified under the Master Plan. However, other sectors, Civil Societies and Community Based Organizations (CBOs) may be coopted in the Monitoring and Evaluation function.

The table below indicate the baseline and anticipated performance indicator for ease follow-up on the relevance, effectiveness, efficiency and impact of activities in the light of each specific objective.

Table 9.1: Baseline data, Target and Timeline for each Specific Objective

Specific Objective	Measure	Baseline 2015	Target	Timeline
To identify current and future demand and supply of natural gas for local and foreign markets	supply BCF per annum	35	1,990	2045
	demand BCF per annum	154	1,990	2045
To set framework for development of infrastructure to supply the market	pipeline km	801	4,855	2045
To develop framework for rational and efficient utilization of natural gas to all sectors of the economy for maximum benefit and alleviate poverty to Tanzanian society	Per capita income (USD)	1,006	1,500	2020
To promote the use of natural gas as	Power Generation (MW)	735	12,302	2045

Specific Objective	Measure	Baseline 2015	Target	Timeline
alternative fuel to charcoal and wood for domestic use, feedstock for value added products, industrial heating, power generation and in the transport sector	no. of households	70	1,707,307	2045
	no. of industries	37	3,749	2045
	no. of motor vehicles	60	467,763	2045
To reduce foreign currency expenditure by replacement of imported liquid fuels	savings per annum (MM USD)	1,036	29,245	2045
To promote the natural gas long term self-sufficiency, security of supply and environmental friendly activities along the value chain	% of proven/reserve	2%	70%	2045

CHAPTER 10. FURTHER WORKS

The logical framework presents activities considered as priorities of natural gas to be used in a sustainable manner, for the benefit of Tanzania. It identifies the decisions to be taken by the Government within the established time limits.

This chapter identifies some of the works that need to be done in order to provide basis for the Government to facilitate implementation of the Natural Gas Utilization Master Plan. This includes:-

- i. Formulation of requisite policies and/or regulations for establishment and operation of gas based industries such as Natural Gas Pricing Policy and Fertilizer Policy;
- ii. Review existing relevant policies to align them with the new emerging gas economy. These include; the Sustainable Industrial Development Policy, 1996; Integrated Industrial Development Strategy 2025, of 2011; National Environmental Policy, 1997; National Health Policy, 2003; and National Forest Policy, 1998.
- iii. Conduct feasibility studies to determine:-
 - a. **Energy park development:** The key activities to be undertaken under this study will cover the following major areas: financial and economic evaluation; location of Energy Park; security of natural gas supply and Management of the Energy Park.
 - b. **Viability of identified gas supply infrastructure:** These include the cost for specific projects, quantity of natural gas required and areas that could accommodate gas projects.
 - c. **Natural gas price:** The price is a major factor of natural gas demand, lower natural gas prices results in increased demand and high prices curtail demand. With lower price, existing customers may switch from another source of energy for some of their energy needs or they may be more likely to purchase equipment powered by the natural gas.
 - d. **Locations of the mega-projects:** The mega-projects should be located at suitably selected centres to maximize the potential for obtaining raw materials to support industrial growth.

ANNEX A: ACTION PLAN

The achievement of NGUMP goals requires a clear definition of roles and responsibilities of all institutions involved, either directly or indirectly, in the various forms of sustainable use of natural gas and its derivatives.

The following table presents, in the form of a logical framework, the activities, indicators and deadlines that must be met for the objectives of NGUMP, translated into strategic objectives, to be achieved in its entirety. The framework identifies government institutions that should lead the process of preparing the relevant decision tools. An important aspect that can be observed in this framework is the principle of efficient inter-institutional coordination.

Table A-1: NGUMP Action Plan

	Strategic objectives of NGUMP	Activities	Responsibility	Key Performance Indicator (KPI)	Time frame
1.	Identifying supply and demand of natural gas for local and foreign markets and supply side operation and management	i. Verify current supply ii. Verify local short term, medium term and long term demand iii. Verify regional short term, medium term and long term demand iv. Identify possible export options for short term, medium term and long term v. Undertake appraisal programme to prove more gas vi. Undertake efficient production systems	MEM TPDC PURA IOCs	i. Volumes of natural gas consumption ii. Projected volumes for local natural gas demand iii. Projected volumes for regional natural gas demand iv. Projected volume for export market v. Additional proven natural gas reserve vi. Enhanced gas recovery	Continuous
2.	Ensuring the availability of gas for the domestic market, facilitating the industrialization strategy of the country.	i. Assessment of GIIP and recoverable reserve ii. Contract renegotiations for domestic volume allocation iii. Review of industrialization strategy for Tanzania iv. Identification of potential natural gas transportation and distribution mechanism. v. Acquire land for LNG and establish Natural gas Industrial Parks vi. Establish Pricing mechanism of domestic gas	MEM PURA TPDC MITI EWURA MLHR PORLGA POPC	i. Volume of GIIP and recoverable reserve published ii. Quantity of natural gas allocated for domestic iii. Industrialization strategy revised iv. Distribution mechanism defined v. Land for both LNG and Industrial parks acquired vi. Natural gas industrial parks established vii. Natural gas pricing mechanism in place	i. Continuous activity ii. July 2016 – June 2017 iii. July 2016 – June 2017 iv. July 2016 – June 2018 v. July 2016 – June 2019 vi. July 2016 – June 2017 vii. July 2016 – June 2017

	Strategic objectives of NGUMP	Activities	Responsibility	Key Performance Indicator (KPI)	Time frame
3.	Facilitating the integration of natural gas industry and other economic sectors in the country in order to accelerate broad based growth and socio-economic transformation	i. Establish Communication strategy to link other sectors of the economy ii. Establish coordination mechanism between actors to manage sector linkage iii. Create and implement awareness program to the general public	TPDC POPC MEM MITI	i. Communication strategy in place ii. Coordination mechanism to monitor sector linkage is in place iii. Awareness program in place and implemented	i. July 2016 - June 2017 ii. Continuous activity iii. Continuous activity
4.	To promote the use of natural gas as alternative fuel to charcoal and wood for domestic use, feedstock for value added products, industrial heating, power generation and in the transport sector	i. Conduct awareness campaigns to promote the use of natural gas. ii. Formulate relevant policies to influence fuel switch	TPDC MEM LGA CSO MNRT MoFP	i. Number of awareness campaigns conducted. ii. Relevant policies in place	i. Continuous activity ii. July 2016 - June 2017
5.	Increasing institutional expertise in matters related to implementation of NGUMP	i. Conduct training needs assessment and prepare training program ii. Train staff from relevant institutions iii. Build capacity of relevant training institutions iv. Prepare establishment of Centre of Excellence for oil and gas	Academic/research institutions MEM MITI TPDC EWURA	i. Training needs in place and number of training programmes established ii. Number of qualified personnel trained iii. Curriculum developed, and necessary training aids facilities provided iv. Site selection and land acquisition done	i. July 2016 - June 2017 ii. Continuous iii. Continuous iv. June 2016 - July 2017
6.	Increasing capacity building and Local Content in matters related to natural gas sub-sector	i. Prepare Local Content regulation applicable for the projects earmarked under NGUMP ii. Create awareness campaign to the community, financial institutions, SMEs regarding NGUMP opportunities; iii. Identify SMEs with their capabilities; iv. Train SMEs with relevant techniques on how to supply goods and services to the natural gas industry.	MEM TPDC MITI IOCs DPs EWURA	i. Local Content regulation prepared ii. Awareness raised to the Community, financial institutions, and SMEs iii. SMEs identified iv. Training programs launched	i. June 2015 - July 2017 ii. Continuous iii. June 2016 - July 2017 iv. June 2017 - July 2018
7.	Establishing a financing strategy for the development of gas projects and for local development initiatives	i. Create awareness to financial institutions (e.g. banks and social security funds) ii. Facilitate the BOT, BOO, BOOT models	MoFP MEM TPDC	i. Launch of awareness programme ii. At least one project financed from these models	i. June 2017 - July 2018 ii. June 2017 - July 2018
8.	Continuous improvement of the fiscal regime regarding natural gas development projects	i. Establish the Implementation Strategies for Petroleum Policies and Acts	MEM MoFP TPDC TEIT Parliament	i. Implementation Strategies in place	July 2016 - Dec, 2017

	Strategic objectives of NGUMP	Activities	Responsibility	Key Performance Indicator (KPI)	Time frame
9.	Ensuring realization of adequate Government share of natural gas, both in kind and cash.	i. Enhance Government participation stake in upstream activities ii. Enhance negotiation skills to Government teams iii. Review existing contract to confirm the required volumes	MEM MoFP TPDC TRA AG Chamber	i. Government participation stake in upstream activities committed ii. Negotiation skills to Government teams improved iii. Existing contract to confirm the required volumes reviewed	i. Continuous ii. Continuous iii. July 2016 – June 2017
10.	Ensuring adequate disaster management systems to prevent adverse impact and protect people's health, safety and environment	i. Prepare needs assessment for disaster management system ii. Analyze and establish disaster management system	VPO PMO MoHA PURA NEMC FIRE BRIGADE EWURA OSHA	i. Needs assessment conducted for each project ii. Disaster management system in place for each project	i. Continuous ii. Continuous
11.	Ensuring that the local communities in the vicinity of oil and gas projects, are given privilege.	i. Carry out assessment of community needs ii. Establish communication channel between community and investor iii. Ensure implementation of CSR	MEM TPDC Investors EWURA	i. Community needs identified ii. Communication channel between community and investor established iii. CSR are effectively implemented	i. Continuous ii. Continuous iii. Continuous
12.	Creating and/or increasing the environmental awareness of local communities	i. Identify environmental issues relevant to local communities ii. Prepare awareness materials iii. Conduct awareness campaigns to local communities	MEM NEMC LGA CBO	i. Environmental issues formally identified ii. Awareness materials available iii. Number of campaigns conducted	i. Continuous ii. Continuous iii. Continuous
13.	Emphasizing on mitigation of environmental damages resulting from the production and use of natural gas	i. Prepare Environmental and Social Impact Assessment (ESIA) for each natural gas project before implementation. ii. Establish environmental damage compensation guideline for the areas where projects are being established. iii. Develop and implement monitoring plan for environmental quality in accordance with the National Environmental Policy (1997).	VPO MEM, TPDC PURA EWURA NEMC & Investors	i. ESIA report for each project in place. ii. Environmental damage compensation plan. iii. Monitoring plan and monitoring reports for each project.	i. Continuous ii. Continuous iii. Continuous
14.	Strengthening institutional capacities for the implementation of applicable legislations	i. Train the entire workforce on international and national environmental regulations and legislations. ii. Create a dedicated team to monitor adherence. iii. Facilitate enforcement of environmental legislation.	MEM, TPDC, NEMC, AG Chamber,	i. Employees trained. ii. Dedicated team established. iii. Regulations and rules in place.	i. Continuous ii. Jan - Dec 2016 iii. Continuous

	Strategic objectives of NGUMP	Activities	Responsibility	Key Performance Indicator (KPI)	Time frame
15.	Facilitating training and capacity building of the national workforce	i. Introduce/strengthen petroleum related courses in Training Institutions ii. Offer refresher short courses to the work force regularly. iii. Increase research funds in the area of oil and gas to increase knowledge on the Oil and Gas subsector. iv. Provide scholarships for Tanzanians for further education in Oil and Gas and related fields.	MEM, MoESTVT, TPDC, IOCs, VETA and higher learning institutions	i. Curriculum developed, and necessary training aids facilities provided ii. Number of refresher courses. iii. Number of research reports and findings. iv. Number of scholarships granted to Tanzanians	Continuous

ANNEX B: GAS INDUSTRY MODELS AND ECONOMICS

ANNEX C: EXPECTED NUMBER OF EMPLOYMENT