

Driving Sustainable Growth through Natural Gas Assets in Nigeria

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Abstract

Natural gas is increasingly becoming a major source of energy in Nigeria. This is singularly demonstrated by new power plants being planned and constructed to use natural gas for thermal generation of electric power. We presented basic facts and challenges, and then, investigated various options available to the Federal Government to optimizing natural gas in Nigeria, for sustainable growth and development. We posit that creativity/innovations in critical decisions, a proper and objective re-engineering and deregulation of the petroleum industry with the evolution of a separate natural gas industry, a well-articulated gas flare down policy beneficial to all stakeholders; coupled with an effective monetization program, are important inputs to optimizing the natural gas assets in Nigeria, to drive and sustain growth. Expectations are that these will translate to the effective functioning and sustainability of core industries, a key requirement to attaining vision 20:2020; the transformation agenda of the Federal Republic of Nigeria. Power, petro-chemicals, and steel, will be major beneficiaries of this proposed optimizing of natural gas assets. The potential impacts, especially, social and economic, will be beneficial on the people, and hopefully, bring about and sustain the desired growth in Nigeria.

Keywords: natural gas, re-engineering, natural gas industry, effective monetization, sustainability of core industries, vision 20:2020, impacts, growth.

INTRODUCTION

The Federal Government of Nigeria, FGN, envisions functional core industries to drive development, and ultimately, sustain growth. The core industries are: energy, power, agriculture, water resources, transportation, steel, and communication. These industries are keys to its vision 20:2020, the transformation agenda/program (FGN, 2007). Vision 20:2020, is expected to place Nigeria among the leading 20 economic nations in the year 2020. Is this expectation feasible with just six years to 2020, when most of the core industries are dysfunctional? Best practices, major requirements to effectively drive and possibly, meet this expectation, vision 20:2020, are not fully in place, namely:

- Effective Government Policies – Fiscal responsibility, functional and stable economy, and effective commitment to democracy.
- Effective Capacity Building of Local Content –Human resource with integrity, functional local technologies, and functional delivery of services.
- Effective Social Factors – Social Responsibilities, Transparency, and stability/peace in host Communities.
- Sustainable Environment – Eco-green solutions and practices leading to green economy and environment.

In this paper, we present probable solutions/ideas for functional and sustainable core industries in Nigeria, especially, energy and power, which will drive and sustain growth. We posit that well positioned energy and power industries, will effectively drive agriculture, water resources, transportation, steel, and communication industries. Nigeria is abundantly blessed with various sources of energy, which through creativity/innovations in critical decisions, will drive and sustain this growth. These energies can be delivered from the following:

- Conventional and Un-conventional Resources of Petroleum, namely:
 - crude oil
 - natural gas assets – natural gas and natural gas liquids
- Coal
- Green Energy; mainly:
 - Water, wind, solar and geo-thermal.

Best practices by the Federal Government, will play the critical role for success in achieving development. We present natural gas as the best and functional source of energy to drive these industries in Nigeria, to successfully attain vision 20:2020, for the following reasons:

- Its abundance in Nigeria: excess of 200 trillion cubic feet of economic gas reserves (Table 1; DPR, 2013)
 - Conventional: Associated and non-associated
 - Un-conventional: Shale gas, etc.
- Its environmental factors – Quality Environment (Adjeh, 1988) :
 - Low sulphur compounds
 - Low oxides of carbon
 - High Gross Heating Value – low levels of inert gases
- Its reliability and wider access to the various industries (Ijevu et al., 2013).

- The Liquefied Petroleum Gas (LPG) sub-industry
- The fertilizer sub-industry

These are major industries that should be producing needed raw materials to drive and sustain the economic environment in Nigeria. All types of steel, namely: flat steel, steel rods, hollow steel pipes and solid steel pipes, are presently imported into Nigeria. The two steel companies in Nigeria, the Ajaokuta Steel Complex mainly for flat steel, and the Delta Steel Complex mainly for steel rods, are moribund. The state of the aluminum industry is not better than the steel industry. The petro-chemical plants attached to the four refineries are under-performing, because raw material(s) coming from the refineries are always in short supply due to the frequent breakdown of the refineries. Also, the liquefied petroleum gas sub-industry is in terrible shape in Nigeria, except for the NLNG, which has started delivering some LPG into the market. Can Nigeria effectively develop with these industries dysfunctional?

Table 1: Reserves of Conventional Natural Gas (DPR, 2013)

Category	Reserves (Tcf)
Associated Gas (AG)	105.00
Non-associated Gas (NAG)	120.00
Total	225.00

TCF – Trillion Cubic Feet = 1,000,000,000,000 standard cubic feet (scf)

Natural gas has been discovered, and is presently exploited, in the following basins, in Nigeria:

- The Anambra basin – an inland (onshore) basin
- The Dahomey/Benin Basin, mostly marine.
- The Niger delta basin – both inland and marine

Earlier, natural gas was seen as a nuisance in crude oil production, and thus, was wasted through flaring. The economic, social, and environmental consequences of this flaring, can be seen everywhere from the host communities to dysfunctional industries (Ijevu et al., 2013), which traditionally, should use natural gas as raw material. Hopefully, through the anticipated petroleum industry bill (PIB), natural gas may be properly exploited and monetized, for effective industrialization and development, thus, driving sustainable growth in Nigeria, through these assets.

Facts on Ground

Four basic facts urgently require the proper exploitation and monetization of natural gas in Nigeria. First, the following core industries in Nigeria are totally dysfunctional:

- The Steel industry
- The Aluminum industry
- The Chemical industry, namely:
 - The petro-chemical sub-industry (Ijevu et al., 2013)

Second, power, a major requirement to the success of vision 20:2020, is in very short supply in Nigeria. The GENCOs, power generating companies, are marginally generating 4,000MW. This is critically short of projected requirements (Idigbe and Onohaebi 2009), noting the abundance of natural gas in Nigeria (DPR, 2013), for thermal generation of electric power. We think natural gas should play the major role in enhancing power generation, and subsequently, supply in Nigeria (Idigbe and Onwuachi-Iheagwara, 2013).

Third, we are witnessing the increasing use of compressed natural gas (CNG) in vehicles in Nigeria. This use of natural gas in transportation is commendable and should be greatly encouraged for greater monetization of our vast economic reserves of natural gas (Ukiri, 2004; Idigbe and Olafuyi, 2003).

Last, many core industries are gradually converting to natural gas from diesel, fuel oil and other traditional fuels of operations. We believe all these will be effectively driven by innovations/creativity in critical decisions and a complete re-engineering of the petroleum industry, to optimizing natural gas assets in Nigeria.

Key Difficulties to Optimizing Natural Gas Assets

There are three major difficulties to optimizing our natural gas assets to effectively drive growth in Nigeria, namely:

- The absence of well-defined natural gas policy, driven by a distinct Ministry (Idigbe and Onwuachi-Iheagwara, 2013)
 - Fiscal regimes, domestic use vs. exports
 - Conventional and un-conventional gas exploitation

- The absence of a comprehensive data base on natural gas
 - DPR should urgently map our sedimentary basins for natural gas assets
- An under-developed domestic market.

The proposed natural gas master plan may not be very effective if these difficulties are not resolved (Idigbe and Onwuachi-Iheagwara, 2013).

Critical Decisions

We posit four major critical decisions that should be made to using natural gas to drive growth in Nigeria, namely:

- Dedication of natural gas with equal status to crude oil, as a major asset for development and growth
- Effective categorization of natural gas assets, with proper exploitation plans
 - Conventional vs. un-conventional
- An effective gas master plan, with properly defined strategies for industrialization
- Re-engineering of the Petroleum industry

Creativity and innovations are desired in making these critical decisions. Nigeria can and has rightly been described as a natural gas province. We ask the following questions:

- How will Nigeria cost effectively, exploit its vast economic reserves of natural gas – conventional and un-conventional?
- Can our natural gas assets be properly positioned to effectively drive our core industries (Idigbe and Onwuachi-Iheagwara, 2013), especially, power?

They are two fundamental expectations from the GENCOs, the generating companies, namely:

- Optimally utilize available and untapped resources for the generation of electric power
- Increase generation capacity and ensure steady power supply to the national grid

Natural gas fits into these expectations, and critical decisions must be made to drive this core industry – power, that is essential to the growth of our micro and core industries.

Re-Engineering of the Petroleum Industry

For over fifty years, crude oil has remained king of energy in Nigeria. We posit the time has come, for a proper focus to be given to natural gas as a major energy source in Nigeria (Idigbe and Onohaebi 2009). Fortunately, the Federal Government is now giving such attention to natural gas, through the petroleum industry bill (PIB), but yet to be passed into law. To optimize the natural gas assets in

Nigeria, we propose a total re-engineering of the petroleum industry, through the following:

A separate and distinct gas (sub-) industry dedicated to effective exploitation, should evolve from the present petroleum industry, as shown in Figure 1

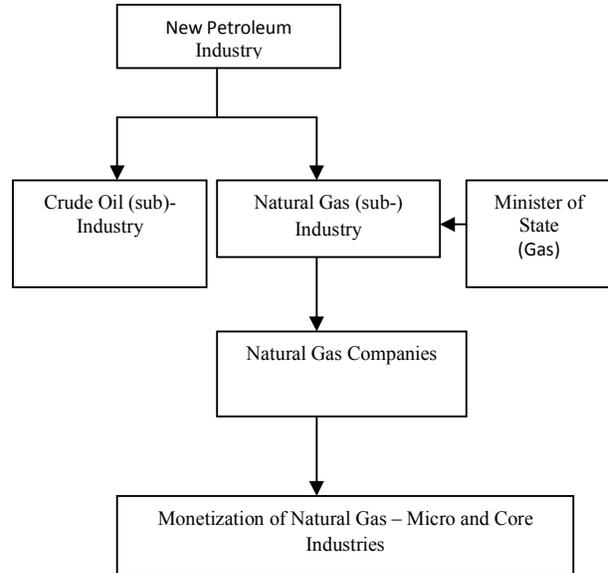


Figure 1: Proposed New Petroleum Industry

- The appointment of a Minister of State for Gas, to oversee the overall activities on gas, as shown in Figures 1 and 2
- Effective fiscal regimes: A total deregulation of the proposed gas industry to encourage private sector participation and objective bidding process for gas assets. There must be a guarantee of safety for investments, especially foreign, through:
 - A re-structured and re-oriented Nigerian Gas Company (NGC), probably renamed the Natural Gas Investments & Management Commission (NAGINMAC) to oversee gas companies and the natural gas assets of Nigeria, in line with NAPIMS.
- An effective natural gas program: A value-focused and environmentally friendly master plan for natural gas – conventional and unconventional, that will ensure sustainable environment, and proper monetization program.

For example, Esau (2003), documented the natural gas master plan for Qatar, whereby all produced associated dissolved natural gas are dedicated to domestic projects, such as power generation, and LPG, Steel and Aluminum production, etc. The non-associated natural gas is dedicated to export-oriented projects, such as LNG, CNG, GTL, etc. We believe

Nigeria should develop a similar plan for natural gas, by making critical decisions. The plan for Nigeria can be enhanced through:

- First, a compilation of complete data base of all non-associated conventional and unconventional natural gas reservoirs in Nigeria, and set for bidding when the owners, usually the IOCs, are not ready to exploit these natural gas reserves. This is presently not available in DPR.
- Second, incorporated gas companies should only develop the non-associated conventional and unconventional natural gas reserves, and must not exploit crude oil reserves.
- Effective fiscal regimes: An effective and dedicated natural gas pipeline program (Idigbe and Onwuachi-Iheagwara 2013), with licenses given to investors for more than 25 years, probably with pioneer status for tax purposes, with:
 - The cancellation of investment tax for new domestic natural gas projects, IPPs, etc., for five to ten years, and
 - The reduction of income tax and other taxes from natural gas (royalty payments, etc.).

The exploitation of non-associated conventional and unconventional natural gas must be given a priority. Then, a truly natural gas industry would emerge, which is urgently needed, to optimize our huge and emerging natural gas assets.

Challenges to Proposed Gas Industry

However, basic challenges will be faced by the proposed natural gas industry. Best practices by the Federal Government to drive and sustain the re-engineering program, is a major challenge. Some other expected challenges are:

- Quality human capital to sustain the gas industry – Capacity building in Human Capital (Idigbe and Onaiwu 2011):
 - Our universities and centres of excellence in learning, are not meeting expectations in quality of human capital, been trained.
- Quality local content in technology, spare parts and core services – Capacity building in Facilities.
- Creating and sustaining best practices in operations by the Gas Companies, for example, creating sustainable environment, during operations.
- The pricing of natural gas. What prices will be charged for natural gas – free market vs. controlled?
- Achieving and sustaining private sector patronage and confidence

Meeting these challenges is very important to the success of the proposed natural gas industry.

Monetization of Natural Gas

Once considered a nuisance in crude oil production, natural gas is now considered a most cost-effective and environmentally safe energy to drive core and non-core industries in Nigeria. Domestically, natural gas is still very under-valued as a major energy and economic resource. Various sustainable and economic projects can be built around natural gas to drive our economy, majorly through:

- Micro industries
- Core industries

Less than 10% of a population of over 150 million people uses LPG as cooking gas in Nigeria (Olukoga, 2002), when it is available. There are three sources of LPG in Nigeria, namely:

- The Refineries,
- The Bonny NLNG Plant, and
- Imports.

By December 31st 2013, the refineries were not effectively functioning, and therefore, not producing needed LPG. The imports were the major source of LPG in Nigeria, although the NLNG Plant at Bonny had started to deliver some LPG into the domestic market. Earlier investigations showed domestic LPG projects using associated dissolved natural gas, to be economically feasible and value-based (Adjeh, 1998; Ukiri, 2004). We ask the following questions:

- Why should our petro-chemical plants lie idle due to the non-availability of the basic raw material, ethylene?
- Can the other dysfunctional industries benefit from greater use of natural gas - Sustainability?
- Should the country rely solely on LNG and GTL projects, for the monetization of our vast economic natural gas reserves?
 - At present, these are the major functional projects on natural gas
- Should we continue to depend exclusively on produced associated dissolved conventional natural gas for our projects, such as the LNG and GTL projects?

To optimize benefits from the abundant reserves of natural gas in Nigeria, we posit that:

- A clear proposal for natural gas – both conventional and unconventional, must be put in place – effective exploitation.
- A sustainable gas flare down edit beneficial to all stakeholders should immediately be put in place, with a penalty for gas flaring.
- A fair market price for gas, per mscf, should apply after this date.

- Establishment of dedicated natural gas plants that should be well defined for effective monetization program. These will be put in place for the proper utilization of the various components of natural gas.

A clear economic and sustainable monetization opportunity is the “gas to chemicals – petrochemicals”. The NNPC reports that ethane, propane and butane constitute about 7 to 12% composition of our natural gas reserves (Ijevu et al., 2013). In Figure 3, we show some petro-chemicals that can be produced from these natural gas components, and also from methane, which constitutes about 82% composition of our natural gas reserves. These petro-chemicals are major inputs to various industries, especially, micro industries.

The Power industry has a great potential for monetizing large volumes of natural gas in Nigeria (Idigbe and Onwuachi-Iheagwara, 2013). By the end of February 2014, generated power was 3,500 MW, as against the needed value of 10,000 MW. Table 2 shows planned and commissioned IPPs by the Federal Government of Nigeria, using natural gas for the thermal generation of electric power. The non-availability of natural gas and infrastructures, such as pipeline, are the major challenges to the functioning of most of the commissioned IPPs.

We suggest effective monetization through two phases, which will accommodate both micro and core industries:

- Primary phase: 1 -5 years
 - Evolve clear direction for natural gas in Nigeria
 - Award of licenses to gas companies and private investors, through best practices by the Federal Government
 - Construction of dedicated chemical plants in Nigeria
 - Olefins Plants ((Figure 3)
 - Construction of LPG Plants in Nigeria, through private ownership
 - Construction of major natural gas pipelines in Nigeria for power, steel, and aluminum core industries
- Enhanced phase:
 - Ensure quality and sustainable supply of natural gas to the plants, through proper monitoring by NAGINMAC

We posit four major stakeholders will drive this program to success, namely:

- The Federal Government – Free Market principles must apply
- Banks – Nigerian and Foreign
- Insurance Companies
- Private investors – Nigerian and Foreign

The effective monetization of natural gas will be a best practice by the Federal Government. We define best practice here, as the decisions, actions, and processes taken; to exploit and monetize natural gas for the development/growth of the economy, that will subsequently, create wealth for the nation. When natural gas is properly exploited for electric power generation, and made available for other industries, then, proper development and growth will evolve in Nigeria.

We believe four key projects can effectively monetize our natural gas reserves to drive growth, when the critical decisions, are made, namely:

- The generation of electric power
 - To effectively drive micro and core industries
- Chemical based projects:
 - Methanol
 - Ethylene
 - LPG
 - Agro-chemicals
- Steel Manufacturing
- Aluminum Manufacturing

We ask the following question:

- Can cost effective synergies be set up locally, to drive the effective monetization program for natural gas?

We believe these can be achieved through establishing dedicated centres for natural gas research, development, and deployment. These will serve as think tanks for all stakeholders, to evolve clear policies and direction for the effective exploitation and monetization for natural gas.

Development and Technology Centres for Natural Gas

Technology and Value Leadership are key inputs to the success of the proposed natural gas industry. However, part of these technologies must be home grown and adaptive to our environment. We propose knowledge centres for capacity building, adaptive natural gas engineering and technology. These will be information and value - driven natural gas sites. Here, development driven tools and projects are innovated, and subsequently made available to industries. Possible focus objectives are:

- Innovating projects for natural gas
- Innovative and value engineering for natural gas exploitation – Sustainable Environment

- Innovative and adaptive technology for natural gas processing - monetization
- Innovative and environmentally friendly designs for gas pipelines
- Designs of cost effective tools/facilities. An example is accessories for vehicles, driven on compressed natural gas (Idigbe and Olafuyi, 2003)
- Design of micro-turbines for low cost Power generation (Orobor, 1998)

The Centre will sustain:

- The promotion of local content in natural gas technology – Capacity building,
- Capture and database of right knowledge in natural gas,
- Functional and value-added research --- turning knowledge into value,
- Access to relevant and cost effective tools.

Huge benefits to Nigeria abound for the success of these centres, namely:

- Sharing and developing key knowledge in natural gas.
- Well designed and articulated natural gas projects for domestic and foreign investor participation.
- Sustainable and reliable power generation.
- Sustainable environment for operations, through proper QHSSE – green environment.
- Employment opportunities and effective capacity building in human resource, local technology, and best practices.
- Micro development of the economy of host communities.
- The development, growth, and sustainability of the economy.

Limitations of Study

In conducting this study, the authors considered only the options that will greatly impact on the optimizing of natural gas assets. The economics of these impacts will be considered in another study. Un-conventional sources of natural gas, with particular emphasis on shale gas, will play a major role in sustaining certain policies for economic growth. A study is being planned to detail economic reserves of shale gas, with infrastructures, to drive the proposed gas master plan, a component of the petroleum industry bill (PIB).

CONCLUSIONS

In this paper, we posited that optimizing natural gas assets will be a best practice by the Federal Government of Nigeria. We desire effective monetization of natural gas assets in Nigeria. Over the years, natural gas, a major economic resource, has been wasted through flaring. Electric power is in a

terrible state in Nigeria. Some core industries that can use natural gas as feedstock are dysfunctional. Yet, the nation continues to flare natural gas. We investigated options available to the Federal Government to optimizing natural gas in Nigeria.

A re-engineering of the petroleum industry is proposed to create a separate and de-regulated natural gas industry. We believe that optimizing the natural gas assets can effectively drive and sustain our core industries. Thus, we suggested:

- The effective dedication of gas as a strategic asset in line with crude oil.
- An effective value-based master plan should be put in place for natural gas –associated and non-associated conventional natural gas, and unconventional natural gas.
- The will by the Federal Government and NAGINMAC to enforce gas flare down, beneficial to all stakeholders, for an agreed date.
- Effective private investors' participation in the new natural gas industry.
- Dedicated natural gas plants to optimize the extraction of gas components for effective monetization.
- Development and technology centres to drive the gas industry.

Wealth creation for the nation will be a major benefit. A major natural resource will drive and sustain the economy of the nation through effective industrialization; sustainable green environment will be created, and less depletion of our foreign currency reserves, from importation of plastics and other petrochemicals, will be achieved. Foreign investor participation, with potential transfer of technology, is expected to compliment local content in human capital, investment and technology.

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NOMENCLATURE

- scf – standard cubic feet
- CNG – Compressed Natural Gas
- DPR – Department of Petroleum Resources
- FGN – Federal Government of Nigeria
- GTL – Gas to Liquids
- IOC – International Oil Company
- IPPs – Independent Power Plants
- LPG – Liquefied Petroleum Gas
- MW – Mega Watts
- NNPC – Nigerian National Petroleum Corporation
- NLNG – Nigerian Liquefied Natural Gas
- NAPIMS – National Petroleum Investments & Management Services
- NAGINMAC - Natural Gas Investments & Management Commission
- PHCN – Power Holding Company of Nigeria
- QHSSE – Quality Health, Safety, Security, Environment

Table 2: Planned Independent Power Plants (IPPs) (Idigbe and Onwuachi-Iheagwara, 2013)

S/N	Power station	Location/site	Status	Capacity (MW)
1	Geregu	Kogi	Some units commissioned	828
2	Mobil	Akwa-Ibom		350
3	Eagle	South		560
4	Papalanto	Ogun	Some units commissioned	670
5	Ibom	Akwa- Ibom		620
6	Gombe	Gombe		500
7	Shell/APP	Afam	Some units commissioned	1000
8	Kaduna	Kaduna		1000
9	Bali	North		500
10	Okitipupa	Ogun		670
11	Agbara-Otor	Delta		450
12	Omosho	Osun	Some units commissioned	
	Total without Omotosho			7,148

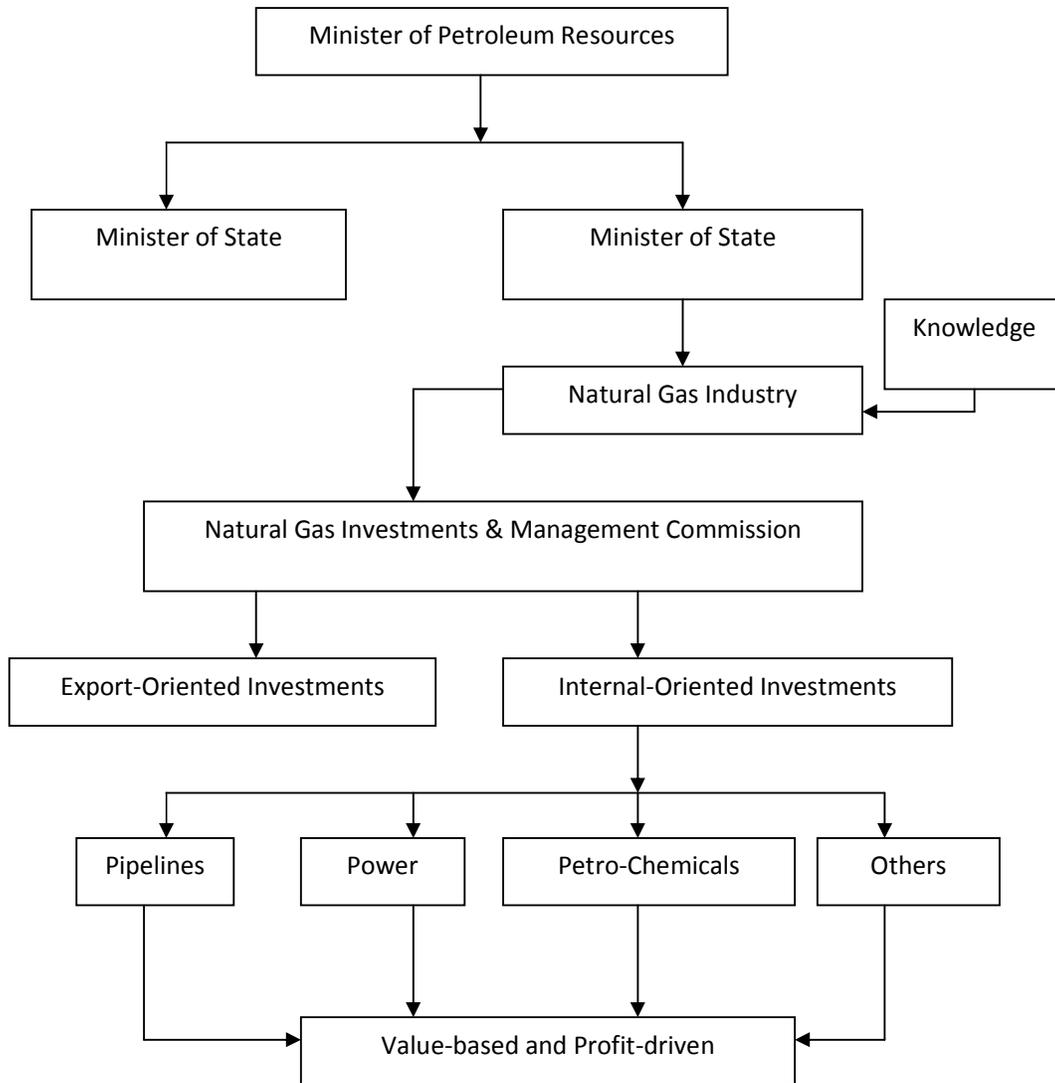


Figure 2: Proposed Re-engineering Program for Natural Gas

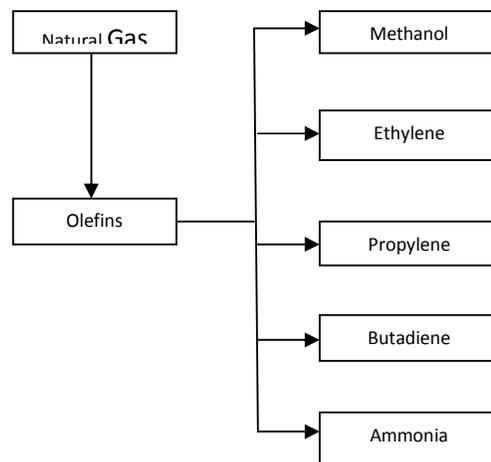


Figure 3: Proposed (Petro-) Chemicals from Natural Gas