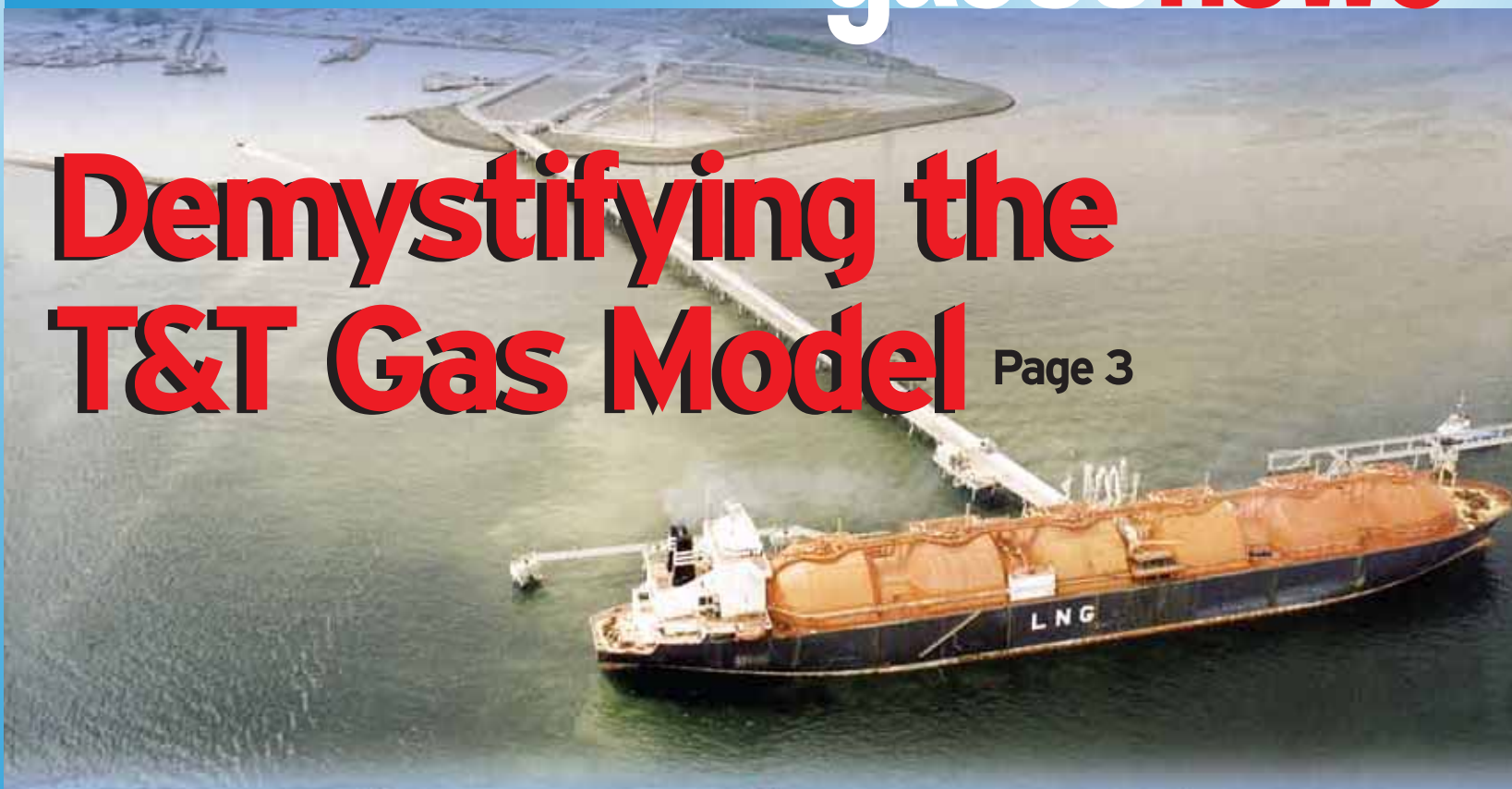
The Corporate Quarterly Journal of
The National Gas Company of
Trinidad and Tobago Limited
GASCO NEWS VOL. 23, NO. 6, JULY 2011

gasconews

Demystifying the T&T Gas Model

Page 3



Building a Sustainable and Diversified Energy Sector

Page 6

gascoNEWS
VOL. 23, NO. 6

July 2011
The National Gas Company of
Trinidad and Tobago Limited (NGC)
Orinoco Drive
Point Lisas Industrial Estate, Couva
Republic of Trinidad and Tobago
West Indies

MANAGING EDITOR
Christine Punnett

CONTRIBUTING WRITERS
Haydn Furlonge, PhD; Vernon Paltoo, PhD;
Tanagna Lessey-Kelly

PHOTOGRAPHS
NGC Archives, Dwight Lake

DESIGN
Lonsdale Saatchi & Saatchi
Advertising Limited

PRINTING
Zenith Printing Services Limited

ALL CORRESPONDENCE TO
GASCO NEWS
c/o NGC Marketing Communications
P.O. Box 1127, Port of Spain
Trinidad and Tobago

PRODUCED BY
The National Gas Company of
Trinidad and Tobago Limited (NGC)

Liquid Fuels Pipeline System (LFPS)

CONTENTS

gasconews
Vol. 23, No. 6, July 2011

21

23

26

S. ANDREW MC INTOSH
President, NGC

SURE AND STEADY PROGRESS

Nothing makes a business leader more proud than when we are able to talk about strong performance, consistent achievement, and the fact that employees are moving as one, with the new strategic mission and vision etched in their minds. Our Mission is that ***"NGC exists to create exceptional national value from natural gas and energy businesses"*** and our Vision is ***"to be a valued partner in the global energy business."***

Two of our major Capital Projects, namely the Union Industrial Estate Pipeline and North East Offshore (NEO) project have been completed and commissioned. Other projects such as the Phoenix Park Valve Station Upgrade, the Liquid Fuels Pipeline Project and Tobago Pipeline will all be commissioned by the end of 1Q2011. These projects alone constitute a Capital Spend of some TT$5.0 billion, a major Project Portfolio in any world-class organization, and have been managed by a skeletal project management staff, a fact that reflects the can-do work ethic of our professional staff. Put another way, the total value of these projects is equivalent to 4 per cent of the country's GDP in 2010.

When a company is as large, technical and diverse in its operations as NGC is, these kudos are an even greater source of pride. In the second quarter of 2011, NGC moved from strength to strength. We closed the period with a net half-year profit of over TT$1.6 billion – and we did so without a single recorded work-related injury.

Although our vehicular accidents are down over last year, half of them could have been prevented. I expect that this time next year we will have substantially reduced the "half". We can never relax our vigilance on our Nation's roads and our work sites, particularly when we are involved in moving such massive pieces of machinery and pipe. I remember the slogan I used to hear on television when I was growing up: *"Safety first; it's up to you!"* It is not our words, but our actions, which will make the difference and positively impact our behaviours.

Our Strategic Plan
The focus of our corporate strategic initiatives will be to ensure the continued sustainability and growth of NGC.

These initiatives include:

- Grow Local Markets
- External Market Development
- Strengthen Financial Asset Integrity Management
- Strengthen Brand and CSR
- Harnessing our Competencies and Culture

Grow Local Markets
NGC has been seeking to integrate natural gas usage in the local market for quite some time by connecting small manufacturing concerns to the natural gas grid. The price and environmental attributes of natural gas make it a very attractive fuel option. These attributes are not lost to the transportation sector where we have been communicating and promoting the switch to CNG as a vehicular fuel, with NGC leading the way as one strategy to integrate gas usage. We are seeking to change out our fleet of vehicles to run on CNG. The first vehicles are expected to arrive before the end of this year. We anticipate that as a result of our lead, new vehicles will be available in T&T which are CNG factory-outfitted. Our former president, Frank Look Kin, NGC's Special Advisor, has been given the mandate to chair the CNG Task Force.

External Market Development
We hear of the varied investment and partnership opportunities and prospects, all of which are at the bedrock of a sustainable future for NGC. We have been seeking international partners to further our objectives in Africa where multiple investment and commercial opportunities are emerging. Success in this area would allow us, for the first time, to provide our employees with international experience. Discussions continue on prospective investments in Ghana and Tanzania and the Eastern Caribbean Gas Pipeline Project.

Strengthen Financial Asset Integrity Management
In parallel with these activities will be initiatives to manage our significant physical and financial assets as well as the initiation of long-term gas reserves and carbon footprint studies. Information about this activity will be provided in subsequent issues of Gasco.

We are making considerable progress in our Physical Asset Integrity Management System project where the offshore platform inspections have been completed. The detailed reports will the core of a major Invitation To Bid (ITB) which will soon be placed on the market for local contractors to completely refurbish our offshore platforms.

Strengthen CSR and Brand
Developing the NGC Global Brand will be key as we seek to expand our business horizons and market our expertise to other developing countries that consider NGC's operations as the blueprint for developing their own. This initiative will require us to implement a sustainable socio-economic development programme in targeted communities, as well as engage in a rebrand or brand strengthening exercise in 2012.

Harnessing our Competencies and Culture
However, it is imperative that our success be based on the engagement and competency of our human resources. We have reviewed our Succession Planning framework to ensure that we prepare the best human resources to fill planned and unplanned employee departures and our leadership development programme is well advanced. In June, we completed the introduction of Personal Development Plans (PDPs) to train our staff to meet future challenges, and efforts are continuing to achieve full alignment between individual performance and corporate strategy through the Individual Performance Contracts (IPC). Effective 2011, individual IPC scores would be considered for both merit and gain-share payments. This mechanism allows us to ensure employee compensation is linked to their contribution to the attainment of our strategic objectives.

In summary, therefore, we are overhauling the way we do things in every aspect of our operations with significant work underway to revise policies, Standard Operating Procedures and to map our critical processes. Our strategic agenda lays it out clearly. I understand that sometimes it is difficult to rise up and see the "big picture" when we have our heads down in the work trenches. I assure you that the churning being experienced as we improve the way we do things is nothing but short-term turbulence. We must stay the course in order to make the requisite step-change and improve our productivity and job satisfaction in the future.

"Do not fear the winds of adversity…. Remember: A kite rises against the wind rather than with it."

Q3 – here we come!

DEMYSTIFYING THE T&T GAS MODEL

With just over 100 years of commercial activity, Trinidad and Tobago's energy sector has demonstrated significant growth, dynamism and diversity. Foreign direct investment, total energy revenues and GDP have grown significantly despite the country's size. The phrase "T&T gas model" is often used to encapsulate a range of strategies, initiatives and decision-making mechanisms that have led to this success story. State agencies such as The National Gas Company of Trinidad and Tobago Ltd (NGC) have played a significant role. With over 35 years as the sector's gas transporter and merchant, the company has developed a strong asset base in gas infrastructure and downstream facilities. As we forge into the second decade of this new millennium, we reflect upon these developments and seek to unravel this almost mystical "gas model" that has taken us so far. This contribution draws from a research paper [1] by H.I. Furlonge (whilst at the Natural Gas Institute of the Americas of The University of Trinidad and Tobago) and M.J. Kaiser (Centre for Energy Studies, Louisiana State University).

By HAYDN FURLONGE, PhD
NGC Asst. Manager – LNG and Investment

During the course of the 20th Century, the mainstay of Trinidad and Tobago's economy transitioned from sugar to crude oil to natural gas. The lack of investment in the sugar industry was precipitated by the early oil-boom years around 1973. The industrialization framework and economic development model of Sir Arthur Lewis also played a key role in this shift. The essential prescription was that industrialization should not be market-based, but rather had to be "engineered" by the State.

The first oil well was drilled in 1857 and commercial production began in 1908. Natural gas was used for power generation in 1953 and as a feedstock for petrochemical manufacturing in 1959 by the Federation Chemicals ammonia plant. The country is now noted for some significant achievements. These include setting new benchmarks for the world's largest ammonia, LNG and methanol plants. There are currently about 800 km of gas transmission pipeline, including the largest diameter pipeline in the western hemisphere. This system currently moves just over 4 billion cubic feet per day (Bcfd) of gas to sheltered deep water harbours on the east coast. The Point Lisas Industrial Estate houses petrochemical facilities and is the world's largest exporting site for ammonia and methanol. At Point Fortin, there are four LNG plants, taking the country up to fifth worldwide in terms of LNG exports. Even though T&T's current proven oil and gas reserves are less than 1% of the world's total, it has the sixth highest hydrocarbon production rate per capita in the world.

This outcome did not evolve sporadically – it could not have, when one considers that neighbouring countries and those in the Atlantic Basin region would have been exposed to a similar social and political history and energy market environment. Several indigenous factors favoured the growth of the industry, including the availability of oil and gas resources in commercial quantities, stable democratic government, the existence of deep water harbours, and the country's strategic location in the Atlantic Basin with access to both American and European markets. In terms of energy policy, the lack of clear and well-documented policy positions makes it difficult for those seeking to understand why and how this relative success has occurred. Yet, there may be others who are oblivious to some of the major developments taking place in this small, resource-rich country.

We touch briefly on gas industry developments during the period 1962 to 2007. The governance of the sector that has facilitated policy formulation and implementation is also considered.

The Formative Years

The first major policy document produced after Independence was a report from a commission of enquiry into the oil industry of T&T. It was initiated by the country's Governor-General, Sir Solomon Hochoy, and referred to as the Mostofi Commission. This addressed policy issues related to growing the oil reserves base and increasing the royalty rates. At first there was no emphasis on natural gas.

A major turning point was the establishment of the Point Lisas Industrial Estate Corporation (PLIPDECO) in 1966, to oversee

the infrastructure of Point Lisas to facilitate natural gas utilization. The country positioned itself to create a national identity in energy, another early manifestation of which was the State's purchase of BP's oil assets in 1969. Overall, there was tangible willingness from the Government to ensure the continued growth of the industry. Private investors could negotiate for terms and conditions that made investments viable, and appropriate incentives were afforded in special cases. Energy was set to play a major role in the economic development of the country. However, the Government was firm in its conviction, even though it had only just gained Independence, not to rely entirely on market forces and foreign interests to dictate the direction of energy sector development.

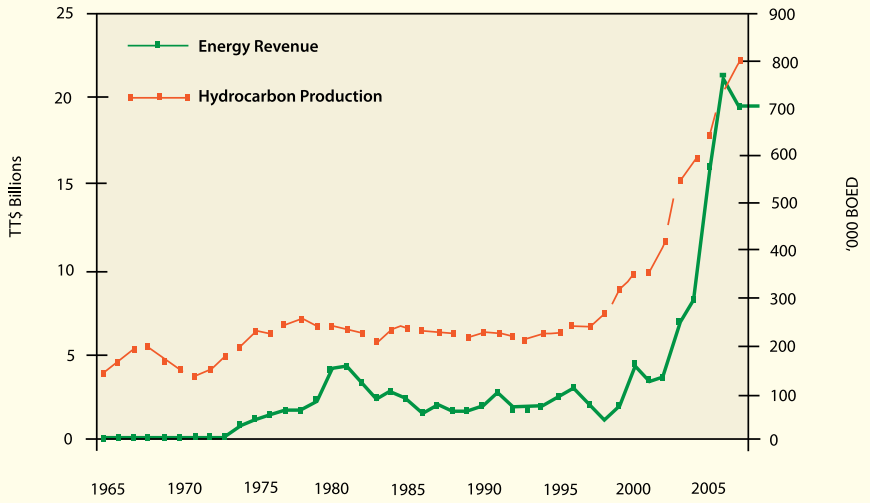


Figure 1: Hydrocarbon production and energy revenue in Trinidad and Tobago

Early energy policy direction and investments in the sector would have set the stage for a doubling of hydrocarbon production to 227,000 barrels of oil per day (bopd), as witnessed during the course of the period 1962 to 1976. Coincidentally, oil prices rose gradually from the US$1 per barrel level to the US$12 range due to the Arab oil embargo towards the end of the period. The combination of these events led to an increase in energy revenues to the T&T Government by about 200%. Figure 1 shows the relationship between hydrocarbon production and energy revenues. Also, the contribution of oil and natural gas to the economy rose from 20% of GDP to the 40% range from the 1960s to 1970s onward. This is a very graphic depiction of how strongly T&T's economy has been linked to growth in the energy sector.

Strategic Growth Period

When Trinidad and Tobago became a Republic in 1976, the main constraints for advancing industrialization were financing and technology. To overcome them Government made strategic investments and deployed a balanced fiscal regime designed to be attractive to foreign investors and provide reasonable economic rents to the State. In addition, there was the development of industrial estates and port infrastructure. The role of the State in gas market development was also critical. Oil production peaked in 1978 at 230,000 bopd *(Figure 1)* while gas production accounted for most of the total hydrocarbon increase towards the end of the century. Oil price increases in the early 1980s lead to a doubling of energy revenues, which facilitated State acquisitions and investments in gas infrastructure.

Now, to what extent was the State willing to invest in the industrialization of the country, and was this linked to nationalization and hegemony? In T&T, the initial approach was to form joint venture partnerships with multinational companies. A couple of the earliest partnerships were with W.R. Grace in the Trinidad Nitrogen (TRINGEN) ammonia plant in 1977, and with American Oil Company (AMOCO) in the Fertilizer Company of Trinidad and Tobago Ltd (FERTRIN) in 1982.

The windfall from high oil prices in the years following the Arab oil embargo meant that the Government was now in a financial position to provide its share of capital (in some cases all the capital) for downstream plants, industrial estates, harbours and infrastructure. Overall, there is little to suggest that State ownership was driven by nationalistic tendencies given that shareholding varied on a plant by plant basis and usually comprised a mix of hydrocarbon producer, technology provider and product marketer.

Later on, privatization and liberalization began in countries around the world. The State maintained a policy of control over the islands' oil refinery, electricity transmission and fuels marketing. In addition, the gas pipeline infrastructure and gas merchant function were strategic State holdings. Thus, the privatization scheme was custom-made to suit the economic situation in the country but also future strategies for energy sector growth.

Greater reliance on capital from abroad was part of the new formula. The change in ownership policy in

fact had not hindered growth of the sector. Transfer of ownership to the private sector provided the important benefit of bringing in global majors in downstream processing, whose expertise and technologies would serve to keep the industry efficient and competitive. On the other hand, the State firmly maintained its interest in the midstream segment of the gas value chain, via NGC. The company was established in 1975, initially to build, own and operate the country's gas pipeline system to keep pace with future growth. The role of monopoly gas merchant was eventually added, i.e. sole purchaser of gas from producers and sole seller of natural gas to consumers. Innovative gas pricing mechanisms with measured gas supply and commodity market risks were applied as a tool of the State for expanding the industry by addressing the specific economic circumstance of new projects. The bundled role of gas transporter and merchant has allowed the company to grow to an asset base of about US$3.5 billion (2007) with investments in gas pipeline infrastructure and other strategic businesses such as LNG and natural gas liquids processing (51% shareholding in Phoenix Park Gas Processors Limited).

The Modern Era and Beyond

After 1982, both revenues and GDP went through a period of decline, followed by a recovery to the end of the 1990s brought on by increasing hydrocarbon production and prices. Yet still, natural gas was set to dominate the energy landscape of the country upon the turn of the century, as noted in the *Green Paper for Proposed Energy Policy.* This turned out to be an understatement as the gas to oil production ratio (in barrels of oil equivalent) rose from 1:1 in 1998 to just over 5:1 in 2007.

The period 2000 to 2007 saw total hydrocarbon production increase from an average of about 215,000 bopd equivalent for the 1962 to 1999 period to about 800,000 bopd equivalent. A number of factors were responsible for this, including significant foreign direct investment (FDI) from the introduction of PSCs, a competitive fiscal regime, tax holiday strategies and new gas-based industries, in particular LNG. The growing dominance of gas over oil effectively represents a shift in the main driver of the economy. The increase in oil and gas/petrochemical prices in recent years has had a concomitant impact on GDP and total energy revenues.

In terms of governance, the growth of the energy sector in T&T has been overseen by a mix of regulators (various ministries), advisors to the State (task forces and committees), and State-owned companies acting as investors, asset managers and commercial operators. A World Bank study compared governance indicators for various countries. Government effectiveness (quality of policy formulation and commitment), regulatory quality (policy implementation and private sector confidence) and political stability (perception of government stability and likelihood of politically-motivated violence), *inter alia*, were considered. Trinidad and Tobago was found to have relatively strong and fair governance, hence an attractive economic and political environment for investment. US$25 billion in FDI since Independence in 1962 is testimony to this. The institutions and decision-making structures in T&T are believed to have played a major role in the growth of the energy sector, and additional attempts such as the Extractive Industries Transparency Initiative are being considered for further strengthening.

In this paper extract we have provided a window into the history of T&T's gas industry and highlighted some of the major policies and strategies that framed the sector's growth and development. However, much remains to be done in terms of using the energy sector to achieve economic sustainability. This is particularly critical at this stage given that T&T is a relatively small hydrocarbon province requiring additional capital for discovery and production to boost falling reserve levels.

To counteract this there are strategies being adopted to encourage FDI in exploration of new acreage, local participation in small and marginal fields, and development of non-traditional sources of oil and gas. The age-old idea of further-downstream hydrocarbon processing is being pursued as a means of establishing linkages between the energy and non-energy sectors, which can contribute to diversification of the country's economy. There are several hurdles to this strategy, both economic (e.g. scale and financing) and marketing (e.g. regional market access and competitiveness) in nature, that must be faced if this is to materialize. Outward FDI, meaning investment by State/local private companies in foreign oil and gas provinces, is another avenue. In this regard, NGC is currently exploring investment opportunities in fast-developing oil and gas provinces abroad.

Unconventional gas resources, increasing fluidity of gas as a traded commodity, competition from new and larger exporters (including the USA) and the green agenda are but a few dimensions of the modern era. The world gas market remains a dynamic place and the challenge is for the country to redefine the "T&T gas model" to capitalize on the opportunities.

Reference

Furlonge, H.I. and M. Kaiser (2010), "Overview of Natural Gas Sector Development in Trinidad and Tobago," *International Journal of Energy Sector Management,* 4(4), pp. 535-554.

BUILDING A SUSTAINABLE AND DIVERSIFIED ENERGY SECTOR – LINKING ENERGY WITH MANUFACTURING

Natural gas is the engine that is moving Trinidad and Tobago forward as we convert gas reserves into tradable products in a diversified mix. World rankings are indicative of our success. Trinidad and Tobago is the global export leader of methanol and ammonia from a single site and the leader in LNG exports to North America. This country is also an important producer on the international iron and steel markets, as well as in the export of crude oil and refined petroleum products.

In shifting the emphasis from primary production to diversification and creating greater value in the natural gas portfolio, the Government of Trinidad and Tobago has taken a policy decision to deepen the linkages between the energy sector and manufacturing industries. The Minister of Finance in the 2010/2011 Budget speech stated: "The Government will institute a clear structure to develop the entire value chain of the energy sector from primary product to finished manufacturing industries."

Therefore, energy-based projects currently being developed are reflective of this policy and are all geared towards optimal use of natural gas in terms of generating revenue from taxes, sale of natural gas and dividends where applicable, as well as at the same time stimulating employment and innovation in manufacturing via the petrochemical, metals and plastics sectors. Diversification of the energy industry would also require the development of the alternative energy sector, as well as the creation of a sustainable energy services sector.

By VERNON PALTOO, PhD
Team Leader – Office of the President
National Energy Corporation

Benefits of Energy-Based Manufacturing Industries

By using derivatives from the primary chemicals in the energy industry to build manufacturing businesses, various benefits could redound to the country. These include:

- Extracting optimal value from natural gas.
- Maximizing revenues from natural gas.
- Creating higher value products and more service industries with energy-based manufacturing.
- Greater contributions to GDP and the economy from the natural gas resource.
- Creating additional industries for the minimal additional quantities of natural gas as would be used for the stand-alone primary product plants.
- Creating sustainable skilled employment.
- Larger number of permanent and construction jobs per unit of capital expenditure.
- Building technical and intellectual resources.
- Enhanced and broader reasearch and development potential by integrating energy and manufacturing industries.
- Impetus and stimulation for high level and specialized manufacturing industries.
- Minimal additional impact on levels of natural gas reserves.
- Development of a sustainable and diversified energy industry.

Furthermore, these smaller manufacturing-type industries have inherent advantages over traditional energy projects:

- Natural gas is used as a fuel as opposed to a raw material
- Minimal infrastructure requirements are necessary for establishing the facility
- Relatively small capital expense for construction of the facility
- Modest utility requirements
- Minimal land requirements
- Less complex and shorter time frame to establish than organic industries

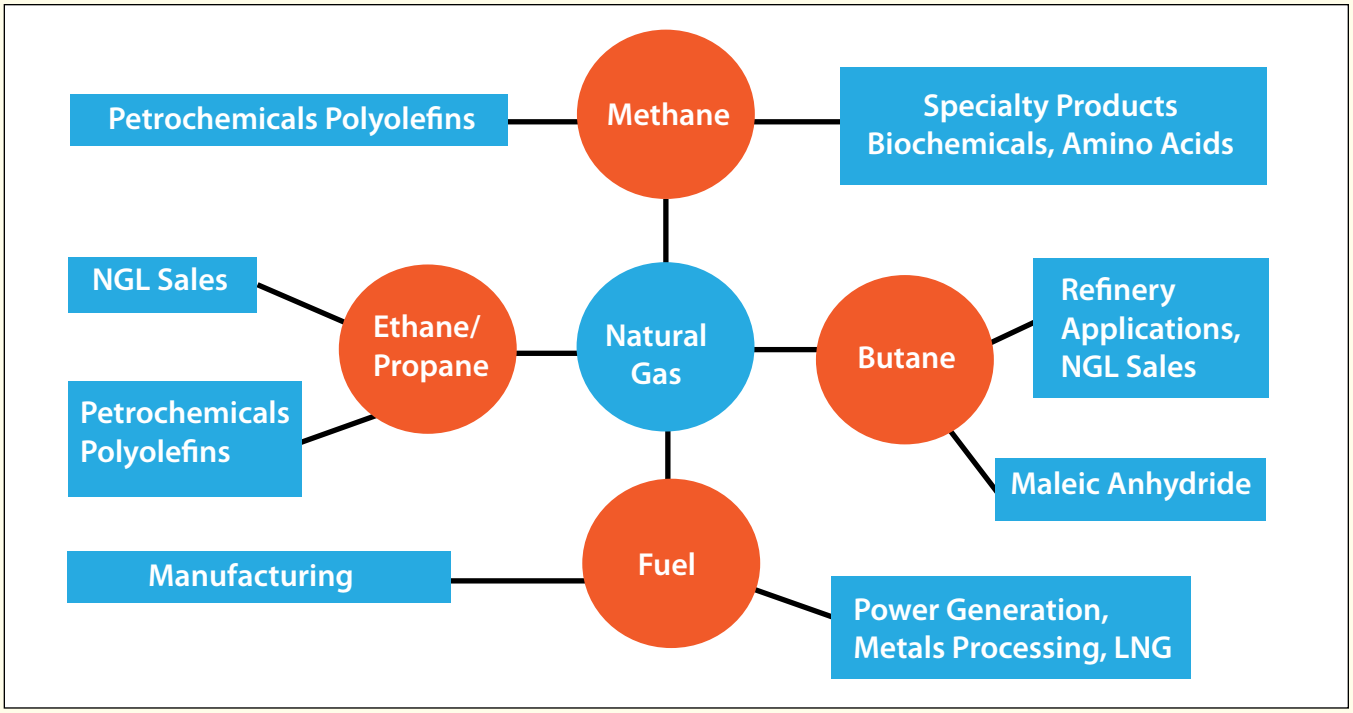


Figure 1: Major Components and Applications of Natural Gas

OPTIONS FOR MANUFACTURING INDUSTRIES

Current Assessment

With the emergence of low cost gas provinces in the Middle East, Russia and Africa, several factors must be considered in a future strategy for the energy sector. These include:

- Expansion in additional methanol and ammonia capacity could adversely affect our position as a key player by further saturating the market.
- As lower cost locations become established in other regions of the world, the capacity for methanol and ammonia may have to be gradually reduced in this country.
- With increased global capacity projected, Trinidad and Tobago's share and influence in the global market will be gradually reduced.
- Development of the shale gas industry in the US would adversely impact our LNG markets in North America.
- There is the need to create greater added-value from natural gas in this country.
- There is the need to create more skilled jobs in the intermediate and downstream processing and manufacturing industry.
- Developing a diversified and sustainable petrochemical and energy industry is critical to the long-term development of the country.

There is need to create more skilled jobs in the intermediate and downstream processing and manufacturing industry.

Natural gas contains four major components: methane, ethane, propane and butane. All of these components have applications which generate value and revenue as illustrated in *Figure 1.* However, these components also form the basic building blocks for major chemicals used in manufacturing finished products. This paper will discuss opportunities for manufactured products using selected chemicals, which are under consideration for development or are already produced in Trinidad and Tobago.

Methanol Downstream – Acetic Acid as an Intermediate

Major intermediate chemicals which can be produced from methanol include formaldehyde and acetic acid. Formaldehyde is primarily used to produce resins in conjunction with melamine (which will be discussed in the next section). Acetic acid is an important derivative of methanol that is used in the production of:

- Vinyl acetate
- Acetic anhydride
- Acetate esters
- Purified terephthalic acid (PTA)
- Chloroacetic acid

These chemicals – when combined with other compounds such as ethylene, oxygen, salicylic acid and others – are used to manufacture products such as *(Figure 2)*:

- From Vinyl Acetate
  - Coatings
  - Adhesives
  - Paints
  - Safety Glass
- From Acetic Anhydride
  - Pharmaceuticals
  - Textiles
  - Fibres
  - Filter Tow
- From Acetate Esters
  - Inks
  - Coatings
- From Purified Terephthalic Acid
  - Polyester
  - Textiles
  - Packaging Material
  - Containers
- From Chloroacetic Acid
  - Pharmaceuticals

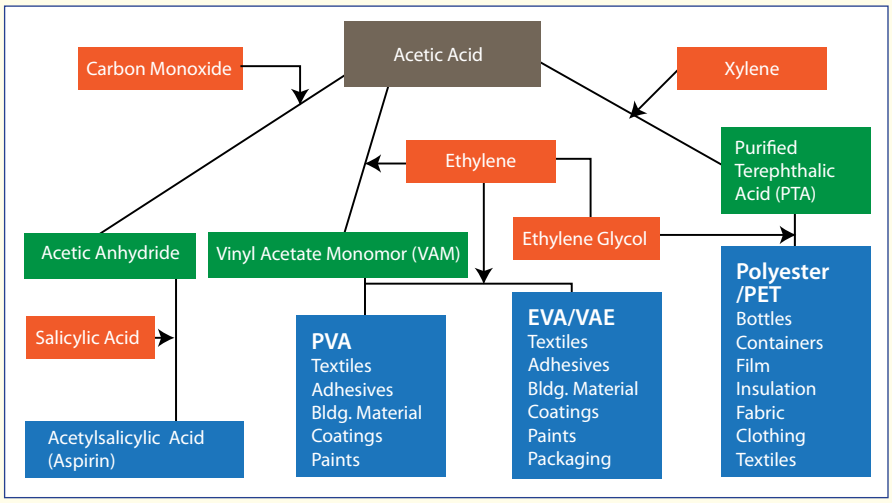


Figure 2: Manufacturing Industries from Acetic Acid

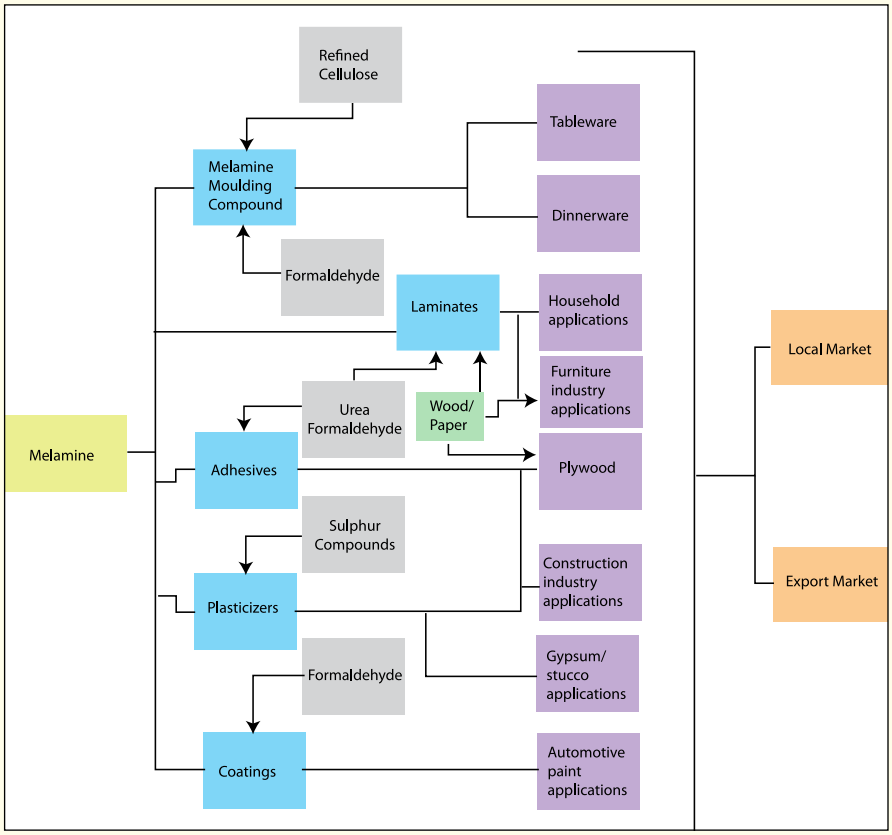


Figure 3: Integrated Melamine-Based Manufacturing Industries

Ammonia Downstream – Melamine-Based Manufacturing

In May 2010, Methanol Holdings Trinidad Limited (MHTL) began producing melamine from its 60,000 tpy production facility, which forms part of its AUM 1 complex. The production of this commodity, downstream of ammonia, provides an opportunity to leverage the strengths of the energy sector in order to develop linkages with the manufacturing sector. As such, the Government initiated the development of melamine manufacturing profiles, which could be used as a tool by manufacturers and potential investors in developing business opportunities and further adding value to the country's natural gas resource.

Applications of melamine together with other chemicals such as formaldehyde are vast and play a vital role in improving the quality, safety, durability and aesthetic appearance of products such as laminated surfaces, adhesives and resins for wood-based panels *(Figure 3)*. For the purpose of developing downstream manufacturing opportunities in Trinidad and Tobago, efforts will be focused on industries suitable for the existing and available markets, infrastructure and logistics, such as melamine moulding compounds, dinnerware, laminates, adhesives, coatings and plasticizers.

The emergence of MTO (methanol to olefins) and MTP (methanol to propylene) technologies has created an opportunity to develop significant chemical and plastic manufacturing industries in Trinidad and Tobago.

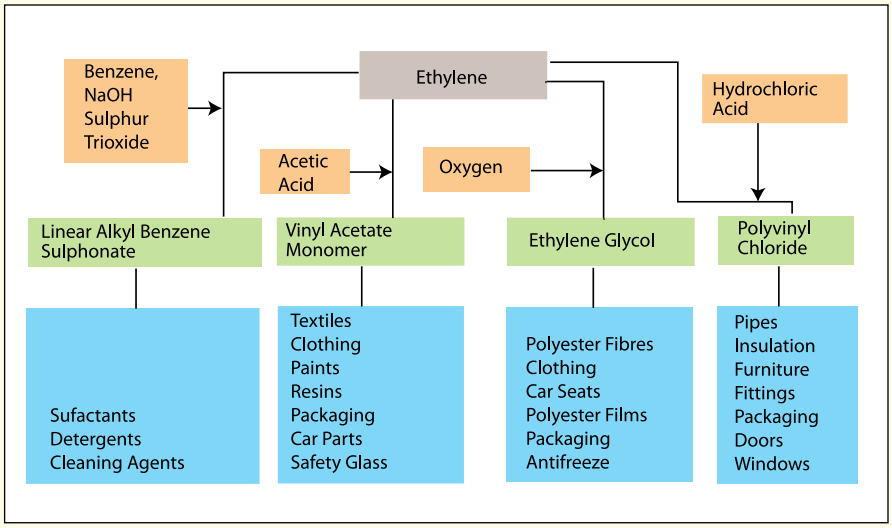


Figure 4: Derivative Chemicals and Manufacturing Products from Ethylene

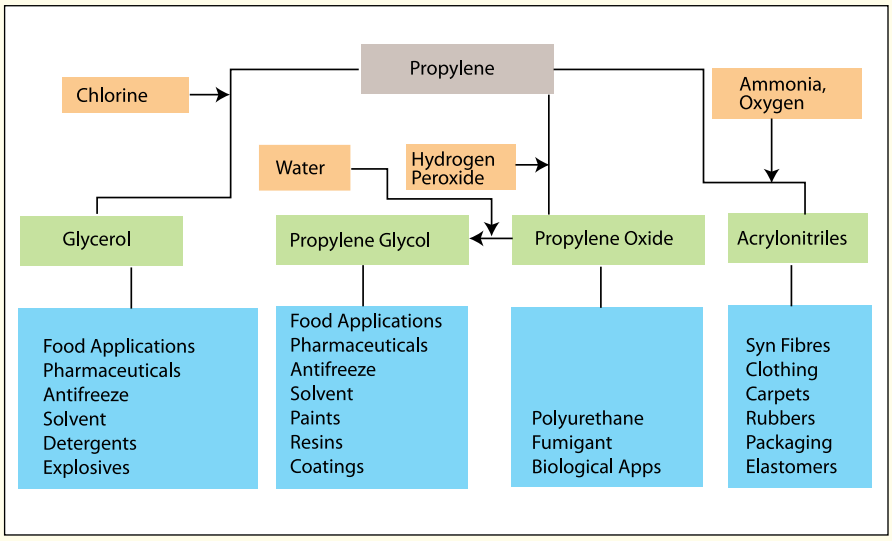


Figure 5: Derivative Chemicals and Manufacturing Products from Propylene

Olefins and Polyolefin-Based Manufacturing Prospects

The emergence of MTO (methanol to olefins) and MTP (methanol to propylene) technologies has created an opportunity to develop significant chemical and plastic manufacturing industries in Trinidad and Tobago. Ethylene and propylene are major olefins, which can be used to initiate a host of derivative chemical and manufacturing industries encompassing detergents, textiles, pipes, antifreeze, coatings and pharmaceuticals, as illustrated in *Figures 4 and 5*.

From future projects that convert methanol to polyethylene and polypropylene, finished products which can be developed include:

- From Polyethylene
  - Containers
  - Pipes
  - Appliance Parts
  - Bottle Crates
  - Film Sheeting
  - Bags
  - Bowls
- From Polypropylene
  - Carpeting
  - Brushes
  - Carpet Backing
  - Rope
  - Film Sheeting
  - Containers

Ethylene and propylene are major olefins, which can be used to initiate a host of derivative chemical and manufacturing industries encompassing detergents, textiles, pipes, antifreeze, coatings and pharmaceuticals.

Appliance Parts
Bottles and Caps
Cups
Toys

Inorganic Chemicals

There is a tremendous opportunity for the development of inorganic chemical industries in Trinidad and Tobago. Examples include products such as calcium chloride, calcium hydroxide, calcium sulphate and magnesium hydroxide. These chemicals have numerous applications in a wide variety of sectors including water treatment, petroleum drilling and agriculture.

Production of Specialty Chemicals and Associated Manufacturing Industries

Butane can be split into iso-butane and n-butane. Iso-butane has applications in petroleum refining for alkylation; while the n-butane can be processed to maleic anhydride, which is an intermediate in the manufacture of various high-value food chemicals and other specialty products which include:

- Unsaturated Polyester Resins – used in Fibre Glass, Automotive Parts, Building Panels, etc.
- Foods And Pharmaceuticals
- Personal Care Products – Hair Spray, etc.
- Domestic Products – Floor Polish, Adhesives, etc.
- Water Treatment Chemicals
- Detergents
- Pesticides
- Agricultural Chemicals

ALTERNATIVE ENERGY INDUSTRIES

Trinidad and Tobago could initiate the development of alternative energy industries by leveraging its strengths in the energy industry. There are potential opportunities to develop wind-based and solar industries, as well as for the manufacture of solar panels. National Energy Corporation (NEC) is a member of the Renewable Energy Committee that is charged with the formulation of a Renewable Energy Policy for Trinidad and Tobago.

ENERGY SERVICES

It is anticipated that with the proper and holistic development of local content, and by extension the energy services sector, Trinidad and Tobago will become a producer and net exporter of energy services for all segments of the energy industry. Therefore the country would eventually become an exporter of intellectual and technical expertise, in addition to energy-based commodities. At the request of the Ministry of Energy and Energy Affairs (MEEA), NEC together with the Energy Chamber of Trinidad and Tobago (ECTT) and other stakeholders completed a "Framework for the Creation of a Sustainable Energy Services Sector and Local Content Programme" in 2010. The Minister of Energy and Energy Affairs in her address to the ECTT's Energy Conference in February 2011 announced that in order to create immediate opportunities for the energy services sector, two recommendations from the report would be implemented in this fiscal year:

i. State energy companies will be required to implement a local content policy to enhance local participation in their projects.
ii. For all incoming projects, local energy service companies will be given specific packages within the project.

CONCLUSION

The ability to develop manufacturing industries from our energy-based projects is critical to the diversification and sustainability of the energy industry and the economy in general. Without the creation of sustainable downstream manufacturing industries, there would be continued reliance on the production of oil and gas along with the primary derivative industries.

The new gas-based industries currently being developed by NEC represent important steps towards diversification and expansion of the energy industry in Trinidad and Tobago. This can only be achieved by the creation of an energy sector that would be able to generate and sustain integrated manufacturing industries. Essential to this would be the parallel development of the energy services sector, as well as enhancement of the human resource base to meet the needs of such industries. NEC is cognizant of its integral role in achieving these goals, and will continue to implement its mandate based on the Government's national energy policy.

Trinidad and Tobago could initiate the development of alternative energy industries by leveraging its strengths in the energy industry. There are potential opportunities to develop wind-based and solar industries, as well as for the manufacture of solar panels.

CAN OPTIMIZATION MODELS BE USED TO CREATE VALUE IN THE LOCAL NATURAL GAS SECTOR?

By TANAGNA LESSEY-KELLY
Business Analyst, NEC

1.1 Global Energy Sector

Today, many serious challenges face the global energy industry:

- Highly volatile oil and gas markets fuelled by geopolitical forces.
- Increased global competition for depleting resources.
- Declines in the skilled workforce.
- Financing issues as shareholders pressure companies for a return on investment commensurate with other long-term strategies.
- Only gradual progress in the sustainable renewable energy sector.

The convergence of these threats and advances in technology have facilitated the emergence of a number of strategic management tools to increase efficiency, effectiveness and global competitiveness in small and large energy companies worldwide. These standard techniques include supply chain management (SCM), enterprise resource planning (ERP) and business process flow engineering.

Key to SCM and ERP is the idea of optimization. These tools are used to optimize decision-making along the supply chain, and they employ sophisticated optimization models that represent a wide range of business applications. This paper focuses on optimization models and contemplates their use as leveraging tools to increase competitive advantage within the local natural gas sector.

1.2 Local Natural Gas Industry

The commercial use of natural gas in Trinidad and Tobago began in 1959 with the start-up of the first ammonia-producing plant, Yara (formerly FEDCHEM). In the years that followed, natural gas-based development grew steadily and operations along the natural gas value chain expanded. The industry's gas utilization within the domestic sub-sector increased from 281 million standard cubic feet (MMscf) in 1990 to 1,312 MMscf in 2010. The complexity of NGC's operations also evolved. NGC's operation now involves purchasing natural gas from different producers and providing processed gas to the domestic gas sector, which includes 11 ammonia plants, seven methanol plants, one urea plant and

Figure 1: Highlights of the Local Natural Gas Industry's Development.

1959	Federation Chemicals Limited pioneers the use of natural gas in Trinidad and Tobago as a chemical feedstock in the manufacture of Ammonia.
1968	1st major discovery of gas field in the East Coast – Teak.
1974	1st major discovery of gas field in the North Coast.
1975	Decision to use gas for industrial development. – The National Gas Company established by GORTT.
1977	24" cross-country gas transmission line established.
1978	24" sub-sea gas transmission pipeline established.
1980	1st gas-fired iron ore reduction and steel mill commissioned – ISCOTT.
1981	Collection and Compression of low pressure associated gas – NGC, Teak and Poui Platforms.
1983	30" offshore/onshore cross-country pipeline installed 1st methanol plant commissioned.
1986	CNG pilot project launched.
1991	Natural gas liquids plant (PPGPL) commissioned.
1999	1st manufacture of LNG in Trinidad and Tobago – Atlantic LNG.
2005	World's largest methanol plant (M5000) commissioned.

four DRI modules in the Point Lisas Industrial Estate (PLIE), as well as five power generation plants, one petroleum refinery and one cement manufacturing plant. NGC also owns, maintains and operates the country's transmission and distribution pipeline network *(Figure 1 see page 11 and Figure 2)*. NEC, a subsidiary of NGC, is engaged in strategic investments in port and marine infrastructure and services, and industrial estates, for which it attracts investments on behalf of the Government.

Along with the increased complexity of operations, other critical challenges face the energy industry in Trinidad and Tobago. These include sustainable industrial development, direction for downstream development, depleting oil and gas reserves, development of the renewable energy sector, gas and land allocation, and increasingly stringent environment standards. To face these and other challenges, key initiatives such as the development of an energy efficiency policy framework for the process plants of PLIE and the development of revised gas evaluation criteria (approved by Cabinet in July 2010), by which all new projects requiring gas as feedstock or fuel would be assessed, were pursued. In light of the aforementioned, the question arises whether other technology tools such as optimization models may also be useful for creating value in the local gas industry.

2. WHAT ARE OPTIMIZATION MODELS?

2.1 Optimization Models in Decision-Making

The most common use of optimization is in decision-making. We use the concept of optimization to decide on the use of our personal time, our route to work, our diet, our investment portfolio, our energy usage plan and in many other aspects of our daily life. It should not be surprising, therefore, that business processes also have optimal outcomes,

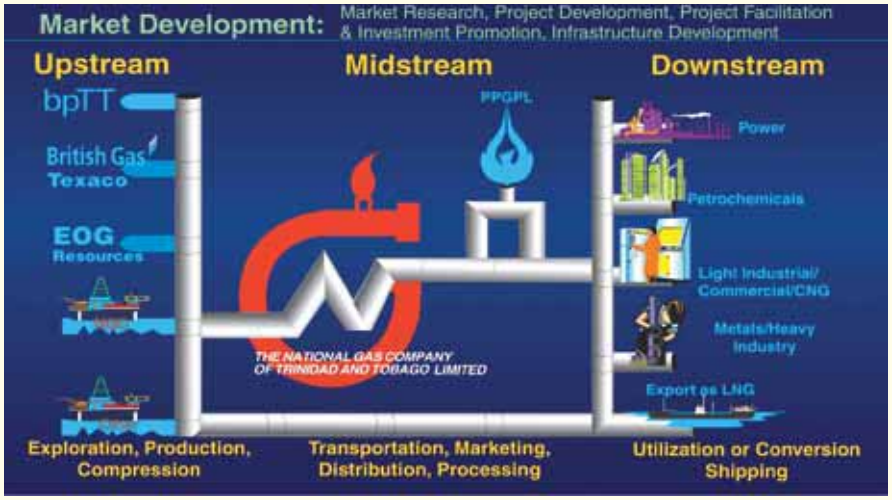


Figure 2: Trinidad and Tobago Natural Gas Value Chain.

and that optimization models (OMs) are used extensively in industry for decision-making.

Models are idealized representations and they play an integral role in business and science. Common examples include the model of the atom, economic models, architectural models, graphs, organizational charts and accounting systems. Such models are invaluable for abstracting the essence of the subject of inquiry, showing interrelationships, and facilitating analysis. OMs are also idealized representations but they characterize the essence of a business problem in a system of equations and mathematical expressions. Just like other models, OMs are used to explore and evaluate business situations, but unlike evaluation models (and most importantly so) OMs are used to determine the best or optimal solution to a situation.

Before optimization technology was available, an experienced analyst would perform a "what if" analysis, considering each issue carefully in an attempt to identify the implications of alternative decisions. However, identifying and quantifying the implications of each variable, in all but the smallest and simplest problems, is not humanly possible. Optimization modelling, though, provides a mechanism for

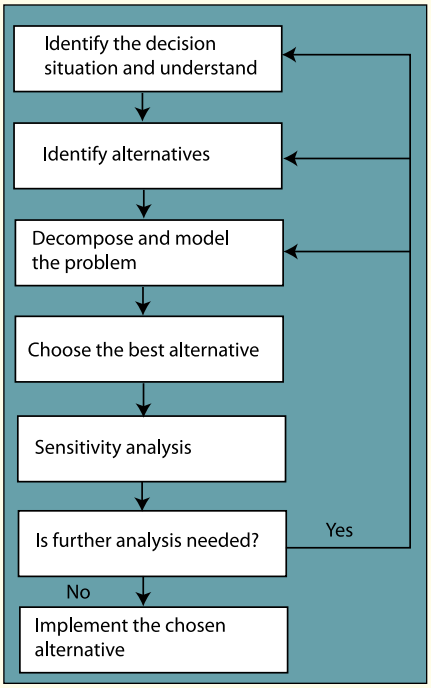


Figure 3: A Decision Analysis Process Flow Chart.

addressing, from a global perspective, all of the business issues pertaining to a problem simultaneously.

A model forms part of a larger system which is used to make choices. The user is able to influence the solutions which the model produces and review them before making a final decision as to what should be employed *(Figure 3)*. This

mode of operation reflects the fact that an OM is not an exact representation of the real world. It can assist in finding good solutions but it is not the complete solution. OMs are ubiquitous in many areas of decision-making, including planning and scheduling, blending problems, process improvement, energy efficiency, work processes, transport and supply-chain optimization.

Some key benefits of the use of OMs in decision-making include:

- Improved operational efficiency which results in improved utilization of resources such as capital, personnel, equipment, vehicles and facilities.
- Access to solutions for the toughest challenges: As the size and complexity of a problem increases the capacity to solve them moves beyond human endeavour and necessitates a technological intervention. Large-scale optimization software can handle thousands or even millions of decision variables and constraints.
- Measurable return on investment: Costs drop, earnings increase and service improves. Some applications save thousands of dollars a year and others save millions – but there is always a return on investment.

In optimization modelling the aim is to choose the values of the decision variables so as to maximize or minimize the objective function, subject to the specified constraints.

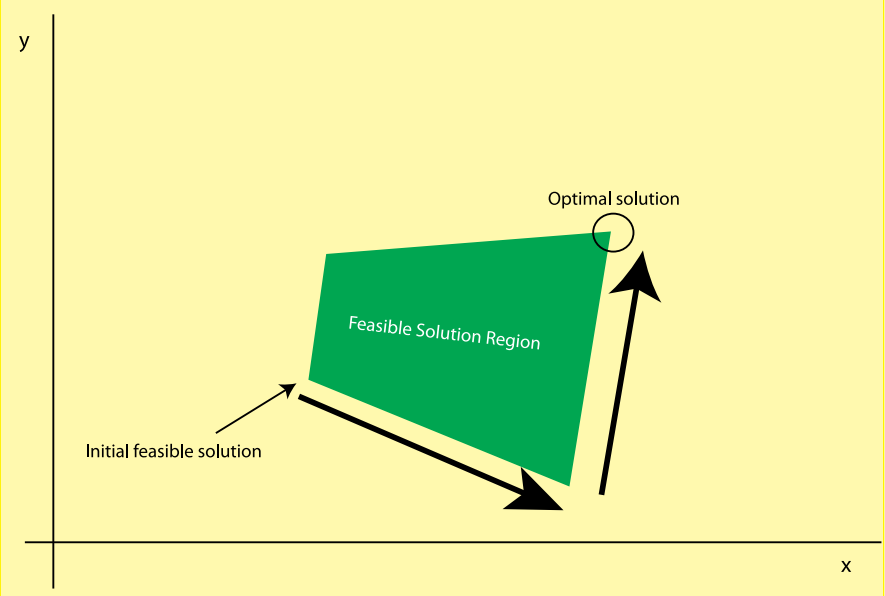


Figure 4: A representation of the feasible region and optimal solution

2.2 Components of an Optimization Model

Optimization begins with the development of a model that defines a problem and its parameters. For example, in a case where LNG sales to different markets must be optimized, each possible business decision is represented as a variable (sales volume, market) while the relationships between business decisions are formulated as constraints (contractual volumes, tank sizes, cargo sizes, quality specifications) and the desired objective (to maximize revenue) is imposed.

These terms are further defined below:

- **An Objective Function:** The quantity you want to maximize or minimize.
- **The Decision Variables:** A set of unknowns or variables which affect the value of the objective function.
- **The Parameters:** Input values that may be fixed numbers associated with the particular problem. Often you will have several "cases" or variations of the same problem to solve, and the parameter values will change in each problem variation.
- **Constraints:** These are relationships between decision variables and the parameters. A set of constraints allows some of the decision variables to take on certain values and excludes others.
- **Feasible and Optimal Solutions:** A solution value for decision variables, where all of the constraints are satisfied, is called a feasible solution. Most solution algorithms (systematic solution procedures) proceed by first finding a feasible solution, then seeking to improve upon it, and finally changing the decision variables to move from one feasible solution to another feasible solution until the optimal solution is found *(Figure 4)*.

In optimization modelling the aim is to choose the values of the decision variables so as to maximize or minimize the objective function, subject to the specified constraints.

2.3 Linear Programming

Quite often linear programming (LP) is employed in optimization models. LP is a mathematical method

for determining a way to achieve the best outcome in a model for a given set of requirements represented as linear relationships. LP arose as a mathematical model during World War II to plan expenditures and returns in order to reduce costs to the army and increase losses to the enemy. It was kept secret until 1947. The founders of this technique are Leonid Kantorovich, a Russian mathematician who developed linear programming problems in 1939; George Dantzig, who published the simplex method[1] in 1947; and John von Neumann, who developed the theory of duality[2] in the same year.

Postwar, its development accelerated rapidly as many industries found valuable uses for LP in their daily planning. LP has found a wide range of practical applications in business, commerce and industry, and simultaneously received a thorough theoretical development. Today this theory is being successfully applied to problems of capital budgeting, design of diets, conservation of resources, games of strategy, economic growth prediction and transport systems. The development of LP is ranked among the most important scientific advances of the 20th century.

LP has found a wide range of practical applications in business, commerce and industry, and simultaneously received a thorough theoretical development.

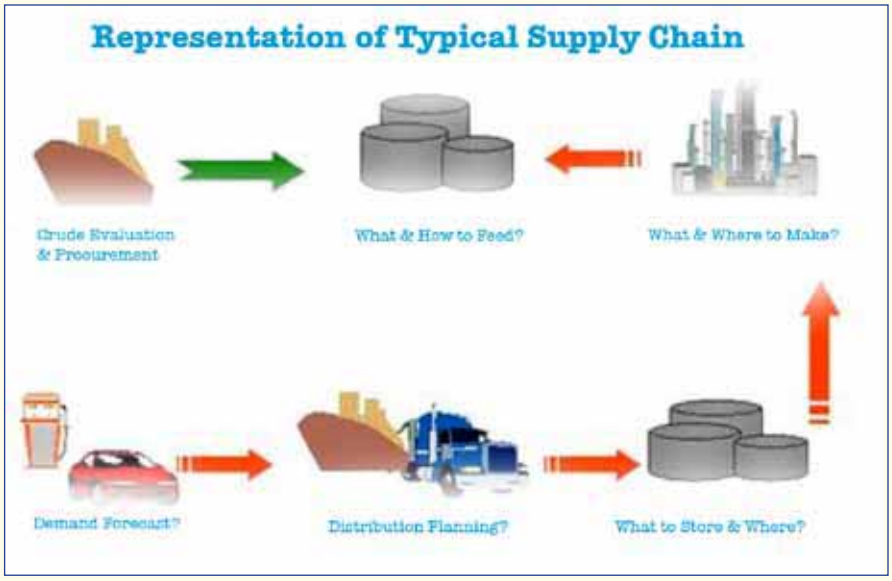


Figure 5: Typical Supply Chain of the Refinery Business.

The key assumption of LP is that all the mathematical relationships (objective function and constraint functions) are linear. Although this assumption essentially holds for numerous practical problems, it frequently does not hold. Therefore, it often is necessary to apply non-linear techniques.

3. CASE STUDIES

Simple optimization models may be designed in a spreadsheet format using a spreadsheet package like Microsoft Excel. A solver is then used to solve the models. More complex problems require the use of powerful modelling languages, like GAMS, AMPL and fast commercial solvers like CPLEX and OSL. Two complex problems are discussed in the following sections.

3.1 Case 1 – Refinery Optimization Model

Problem description: The petroleum refining business involves a wide spectrum of activities, starting from crude purchase and crude transportation, refining operations, product transportation and finally delivering the product to the end user. The operations are extremely complex and heavily linked but there exists a great degree of freedom (blending options) for satisfying the required product specifications *(Figure 5)*. The need and scope for optimization is so vast in a refinery that it is essential to use software tools not only to arrive at the best plan, but to quickly evaluate the new optimum with internal or external changes in the business scenario.

Optimization model

Refinery planning and optimization is mainly addressed through successive linear programming software like RPMS (Honeywell Hi-Spec Solutions), PIMS (Aspen Technology) and GRTMPS (Haverly Systems). PIMS is most extensively used, with about 75% of

1) Simplex method A standard technique for solving LP problems. In brief, the simplex method passes from vertex to vertex on the boundary of the feasible region until either an optimal solution is found, or it is established that no solution exists (Figure 4).

2) Theory of duality The duality theory states that optimization problems may be viewed from two perspectives. This concept of duality is useful to obtain additional information about the variations in the optimal solution when changes are effected in the constraint and parameters in post-optimal or sensitivity analysis.

the refineries worldwide, including the regional oil refineries Petrotrin and Petrojam Limited, using this application.

Objective function: A refinery LP model is generally configured with the single objective function of maximizing the profit margin.

Applications of the refinery LP model:

- Crude and feedstock selection and evaluation.
- Assessment of plant performance.
- Evaluation of alternative feed stocks.
- Optimization of product mix for a given feed slate.
- Optimization of product blending and other operating decisions.
- Evaluation of plant configurations and modifications.
- Planning of feed stock and product inventory.
- Capital investments evaluation for process equipment.
- Preparation of the annual, monthly, weekly, strategic and profitability improvement plans.

Value creation:

- Facilitates the decision-making process by keeping the focus on profit under any scenario.
- Provides the targets and operating strategies for the actual operations.
- Quantifies the impact of a change in a variable on overall refinery profitability.
- Provides for potential margin benefits.

3.2 Case 2 – GassOpt: Creating Value since 1995

Problem description: The natural gas value chain in the Norwegian continental shelf (NCS) includes production, transportation, processing, contract management and sales. Firstly, the natural gas is transported from production fields to processing plants or transportation hubs where gas from different fields is mixed. Rich gas components are extracted and sold in separate markets. The remaining dry gas is transported to the import terminals in the UK or on the European continent. Also, upstream markets exist where the gas is sold before it is transported to the import terminals.

The NCS gas value chain includes 7,800 km of large diameter pipelines, riser platforms, gas processing plants and receiving terminals located in four European countries *(Figure 6)*.

Figure 6: Natural Gas Pipeline Networks in NCS.

A refinery LP model is generally configured with the single objective function of maximizing the profit margin.

Optimization model

A gas network optimization programme (GassOpt) was developed for transport analysis and planning purposes in order to calculate the optimal routing of natural gas in the pipeline networks. It is used by StatoilHydro and Gassco and was implemented in 1995.

Objective function

The goal is to route the gas flow through the network, to meet the demand in accordance with contractual obligations (volume, quality and pressure) and to minimize the energy needed to maintain the necessary pipeline pressure. The optimization tool handles blending of different gas qualities from different production fields and includes compression and process units.

GassOpt has been applied in:

- Identifying bottlenecks
- Transportation planning
- Infrastructure development (pipelines, process units)
- Yearly field maintenance planning
- Quality nomination process
- Deliverability studies
- Blending studies

Natural gas is delivered to a number of process plants at the Point Lisas Industrial Estate for use in ammonia, methanol and metal production.

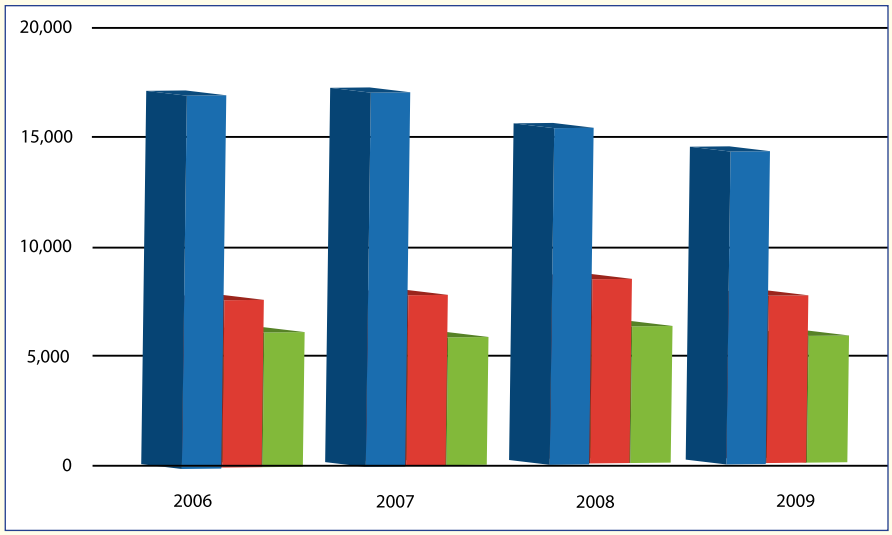


Figure 7: Trinidad and Tobago Unrisked Gas Reserves
Source: MOE&EA Trinidad and Tobago Gas Reserves Certification Year Ending 2009

Value creation:

- Reduces losses during temporary production shutdowns.
- Prevents investment decisions shown to have a significant negative effect on other promising field development options.
- Increases precision in transport capacity booking.
- Increases precision in field development decisions.
- Increases the ability to deliver gas within specification.

4. FOOD FOR THOUGHT – CAN OMS HELP WITH THE CHALLENGES FACED IN T&T'S ENERGY SECTOR?

As discussed previously, the energy sector in Trinidad and Tobago is faced with a number of challenges – issues of sustainable industrial development, direction for downstream development, depleting oil and gas reserves, development of the renewable energy sector, gas allocation, land allocation and increasingly stringent environmental standards. As such, managers and government officials are required to make a series of important and difficult decisions, which are comprised of many "decision variables" and "constraints" with the overriding "objective" to maximize the value created from our natural resources.

In the section that follows, a high-level description of how optimization may be used to assist with gas allocation challenges is presented for consideration. Gas allocation is a critical area for decision-making as issues of depleting natural gas reserves *(Figure 7)* are now at the forefront of many discussions.

A. Gas allocation to PLIE

Challenge Description: Natural gas is delivered to a number of process plants at the PLIE for use in ammonia, methanol and metal production. The supply of natural gas to the customers is governed by long-term natural gas supply contracts with NGC. The selling prices to these various customers are different, as commodity-linked netback pricing formulae are used. Therefore as commodity prices fluctuate, the gas price and the revenue to NGC and Government will fluctuate. The challenge is also greater because the plants operate at different natural gas conversion efficiencies.

Potential for Optimization:

An optimization tool for gas allocation to PLIE would aim to maximize direct revenue from gas sales (objective function) with the main decision variable being volume allocated. This model could be used for delivery planning and to support contract renewal negotiations. It will be useful for price assessment analysis and examining the profitability of product streams.

B. Gas allocated to new projects

Challenge Description: Gas must also be allocated to new projects for use as a feedstock or for fuel. At present, the selection of projects is governed by revised evaluation criteria (approved by Cabinet in July 2010). These criteria assess the new projects using the following categories:

- Degree of value added
- Environmental impact
- Capital expenditure
- Degree of local content
- Extent of variation with gas price
- Early construction plan
- Energy efficiency
- Variation in terms and conditions for power and other utilities
- Variations on estate and pier rates
- Additional benefits (corporate and social responsibility)

Potential for Optimization:

An optimization tool for use in the evaluation of new projects would be more complicated than one for gas allocation to PLIE. In the case of the evaluation of new products many more decision variables (type of project, volumes, prices) and constraints (gas availability, land availability, berth occupancy, market availability, environmental impact) must be considered. The objective of such a model would aim to maximize value creation, which would be a multifaceted objective considering all of the quantifiable decision criteria. This tool would be useful for simultaneously handling the economic, environmental and operational categories of the approved criteria, and also may be used to incorporate additional issues (land usage, berth occupancy, gas availability). Some of the categories in the evaluation criteria though (like local content, early construction plan and diversification) will be less easily quantifiable and may not be able to be incorporated in a model. This must be considered in the decision analysis process *(Figure 3)* and the final decision will have to consider both the model output and the impact on overall value of any criteria group that cannot be modelled.

Optimization may also assist with other challenges – probably to solve natural gas pipeline network distribution problems (such as in the "GassOpt" example), or even to examine environmental concerns. To ascertain all the uses of optimization in the sector, and the possible benefits, a rigorous examination of the problems will be necessary.

5. QUESTIONS FOR REFLECTION

OMs have been creating value by helping to solve difficult problems since the 1940s. The technology is fully advanced and many of the modelling software packages available are easy to use. But, can the intricacies of T&T's natural gas business be modelled efficiently? In considering this, we must answer the following questions:

Is the industry at the right stage for the use of technology tools like OM?

Can the use of OMs assist with decision-making in T&T's gas sector?

Can it be used to create value, improve profit margins or reduce costs?

Are we at present gaining the optimal value from our natural resources? Or are we leaving value on the table?

When the answers to these questions are determined, we may then make conclusions about the relevance of optimization as a tool for value creation in Trinidad and Tobago's gas sector.

Optimization may also assist with other challenges – probably to solve natural gas pipeline network distribution problems, such as in the "GassOpt" example, or even to examine environmental concerns

References:

1. F.S. Hillier, G.J. Lieberman, *Introduction to Operational Research,* Seventh Edition, McGraw Hill Series in Industrial Engineering and Management Science, 2001
2. R.T. Clemen, *Making Hard Decisions, An introduction to Decision Analysis*, Second Edition, Brooks/Cole Publishing, 1996
3. *Petroleum Refinery Planning and Optmization Using Linear Programming*, http://www.cheresources.com/refinery_planning_optimization.shtml
4. K.C. Baumann, R. Albrechtsen, M. Carlsen, F. Romo, *Transport analysis of the dry gas network system on the Norwegian Continental Shelf using a network Optimization tool* (Paper presented at the PSIG Annual meeting, San Antonio, 2005).
5. A. Tomasgard, F. Romo, M. Fodstad, K. Midthun, *Optimization Models for the Natural Gas Value Chain,* Norwegian University of Science and Technology.
6. *High-Level Look at Optimization: Past, Present and Future,* eopt.informs.org/resources/opt_primer.doc

NATIONAL GAS COMPANY EMPLOYEE RECOGNITION AWARDS 2011

CELEBRATING EXCELLENCE, COMMITMENT AND TEAMWORK

At an Awards Ceremony entitled "Carpe Diem" ("Seize the Day") held on May 6, 2011, NGC honoured 86 employees for their dedication and contribution to the company's success. The Honourable Carolyn Seepersad-Bachan, then Minister of Energy and Energy Affairs, Chairman Larry Howai, President S. Andrew Mc Intosh, Human Resources Manager Susan Campbell-Nicholas and Long Service Award recipient Gerard Francis praised and thanked staff for their achievements, and fuelled their passion for greater achievement as the company implements its new five-year Strategic Plan.

A cross-section of employees who received awards

LONG SERVICE AWARDS FOR 2010

30 Years

Ronald Mieres
Russell Ramdass*
Sharon Thomas-Hinds*

25 Years

Andrew Salvador
Brian Herbert*
Erva Davidson*
Franklin Daniel*
Jacqueline Tyson*
Jennie Alleyne
Maria Thorne*
Ronald Armour

20 Years

Aldwyn Redhead*
Anarood Lalchan*
Ann Marie Skinner*
Byron Madoo
Carol Nock-Sebro*
Dale Baxter
Derick Ferrier
Dino Balgobin*
Donna Jackson*
Francis Flores
Gerard Francis*
Gregory McGuire*
Indra Timal*
Kaisraj Panchoo*
Kay Boodram*
Marina Dukhedin-Lalla*
Michael Pierre*
Nicole Sheppard*
Patrick Bynoe
Premchand Sookdeo*
Siew Ramdass
Sunil Latchman*
Vera Bahall-Gunness
Wade Hamilton*

15 Years

Angela Roberts
Anthon Smith
Carol Sylvester-London*
Cherryl Findlay
Claudine Charles
Danford Mapp
Erica Joseph*
Gerard Callender
Haydn Jones
Joseph Allan*
Joy Roberts*
Junior Beharry*
Junior Phillip
Lincoln Anthony
Lisa Burkett*
Lisa Shah-Chung*
Lloyd Coutain
Maria Bridgemohan*
Marva Bellamy-Bostic*
Natalie Lopez-Joseph*
Rhea Mends*
Sherry Ann Mc Lean
Sircliffe Thompson*
Subhasny Ramsaroop*
Terrance Belton
Vanisa Pargass*
Wayne Thomas*

10 Years

Allison Marchand
Anester Springer
Antonia Ferrier
Camille Hackshaw
Chrissy Roachford
Dominique Taylor
Ezekiel Ramlal
Georgia Garbo-Noel
Indira Teelucksingh
Lesley-Ann Mc Tair
Loren Hills
Mallini Samsoondar*
Melina Atherley-Gonzalez
Michelle Jackson
Michelle Scipio-Hosang

NGC's President's Special Award

Gregory McGuire – Senior Manager, Office of Strategy Management (OSM)

Pettreena Jewnath-Gopie
Rabia Ali
Ravi Narinesingh
Ronald Kailah
Rudolph Rullow*
Samuel Griffith
Shelley Anne Edwards
Wendy Rampersad

Special Mentions

Hyacinth Guerra-Headley achieved 20 years' long service in 2008

Natasha Harrichand-Kooarsingh achieved 10 years' long service in 2007

Sandra Thomas-Williams achieved 10 years' long service in 2008

Alicia Bocus achieved 10 years' long service in 2009

Natasha Cudjoe achieved 10 years' long service in 2009

Safety Awards Recipients 2010

Jagdeep Ganpat
Rosanne Soulette
Indra Timal
Ronald Armour
Terrence Hart
Vera Gunness
Andrew Pyankaroo
Cherryl Findlay
David Darsan
Motilal Boodoosingh (retired)
Alicia Bocus
Nazim Sarjad
Rochan Kaseram
Rodney Ragoonanan
Rolston Waithe
Selwyn McLeod

**These Long Service Awardees also won Safety Awards*

NGC's Best Project Team Award

GIS Surveying Section: Naieem Mohammed, Nicholas Mookram, Francis Martinez

NGC's Spirit Award

Measurements and Gas Transmission and Distribution (GTD) Salicram Ramkisson

Celebrating the Life: An NGC Pioneer

Knollys Ahloy – NGC's first General Manager

The project was a major undertaking and a crucial step in the energy development of the nation. With just a few years of work under his belt, Knollys was challenged with one of the important projects of the time – and he rose admirably to the occasion.

Knollys Ahloy was, quite simply, a founding member of NGC and a pivotal player in the development of the natural gas sector in Trinidad and Tobago. His story is inextricably cemented into that of NGC, a landmark of our country's energy history.

As a young man, Knollys attended the renowned Colorado School of Mines, a public teaching and research university devoted to the engineering and applied science with expertise in the development and stewardship of the earth's natural resources. After graduation he returned to Trinidad in 1960 as a Petroleum Refining Engineer.

Knollys would go on to work at the Trinidad and Tobago Electricity Commission (T&TEC) and in 1963 he would be chosen to head the newly established Gas Transmission Department within the organization. The department was created to facilitate the construction of the North-South Gas Transmission Line. The project was a major undertaking and a crucial step in the energy development of the nation.

With just a few years of work under his belt, Knollys was challenged with one of the important projects of the time – and he rose admirably to the occasion.

When the decision was made to form the National Gas Company in 1975, Knollys was appointed to start up the operations of the new company as its General Manager. All the records and personnel attached to the T&TEC Gas Transmission Department were in turn transferred to the National Gas Company.

Knollys' service to the company continued for many years. He was appointed twice to the Board of NGC between 1975 and 1992. Under his leadership the company grew to become a respected manager of the state's natural gas resources and in turn Trinidad and Tobago has grown to become a respected player in the international energy market.

We mourn the passing and celebrate the life of our dear Knollys Ahloy, NGC and energy pioneer, and send our heartfelt sympathies to his family at this sad time.

Liquid Fuels Pipeline System (LFPS)

LFPS Update

Work continues on the Liquid Fuels Pipeline System (LFPS), which NGC has been contracted to construct on behalf of the GORTT. The first segment of the 8" pipeline will take gasoline, diesel and jet fuel from the Petrotrin compound at Pointe-a-Pierre to the Caroni facility currently under construction, and a second segment will take jet fuel from that facility on to Piarco International Airport.

As at the end of July, the construction of motor-operated valves at either side of the Couva, Caroni and Guayamare rivers is 70% completed, having been delayed somewhat because of recent rainy weather. These valves will be used to isolate sections of the pipeline in the event of leakage. Following the installation of the valves, the line will be pigged and connected to the terminals.

Petrotrin is in the process of constructing a cross-refinery pipeline from the eastern refinery at Gasparillo to the main supply tanks, which will be located at the western side of the refinery. Construction of this pipeline has been delayed but is expected to be completed by the end of the year. Civil works in support of the tank facility on the Petrotrin compound are also taking place and will be completed according to the same schedule. These works include foundations for pumps and other equipment and the construction of dikes surrounding the tanks. The tanks themselves will be completed by September. There are also electrical works taking place.

At the Caroni facility, all tanks have been completed and connections are being made to the pipelines. Foundations for all supporting equipment are also completed.

The main control building is 90% completed and work on the smaller buildings, such as security and electrical structures, is ongoing. After these are completed, the electrical and installation (E&I) work will be undertaken. The contract for supply of cable for this purpose has been awarded and the E&I work has begun and is scheduled for completion in October.

The entire Caroni facility is being paved, and these works are 75% completed. A separate contract will go

out to tender for the construction of an access road from the Caroni Savannah Road into the facility. Bids are expected by the end of August, whereupon the contract will be awarded and work will commence.

Mechanical works have begun at Piarco, where two additional tanks for the containment of jet fuel have already been installed. These works are being performed by the National Petroleum Company of Trindad and Tobago (NP) and will continue until the end of the year.

When the Liquid Fuels Pipeline System is in use, the transportation of liquid fuels from Petrotrin to Sea Lots by sea will be discontinued, and the Sea Lots compound will be shut down. There will also be no need for the transportation of jet fuel to the airport by road tanker.

NGC Tests Alternative Work Schedule (AWS)

As of July, NGC has begun a six-month pilot project to test an Alternative Work Schedule, similar to the 9/80 work week popular with many players within the energy industry. The purpose of the AWS is to offer more flexible working options to employees, improve work/life balance and allow employees a day off in which to fulfil personal obligations.

The new system applies to employees who normally work Monday to Friday and excludes shift and offshore workers. Under the new system, employees will complete their contracted hours per fortnight over the course of nine days rather than ten, giving them one Friday off every two weeks.

During the test period, NGC will be monitoring and fine-tuning the system. Following this, feedback will be solicited from staff at all levels and a decision will be taken as to the possible implementation of the AWS as a permanent system.

The main metering facility at Union, as well as the metering station at TGU, have been commissioned. The plant has been taking gas intermittently since this time, which is being used to test their equipment.

TGU Begins Taking Gas at Union Industrial Estate

Following the completion of the major works on the Union Industrial Estate pipeline project on April 20, 2011, natural gas has begun flowing to the Trinidad Generation Unlimited (TGU) power plant. The main metering facility at Union, as well as the metering station at TGU, have been commissioned. The plant has been taking gas intermittently since this time, which is being used to test their equipment.

The 8” high density polyethylene (HDPE) distribution pipeline, which will supply light industrial and commercial (LIC) users on the Union and LABIDCO industrial estates, has been constructed, with the exception of a horizontal directional drilling (HDD) operation to connect the segments of pipeline on either side of the Southern Main Road. The HDD will begin in mid-July.

The overall scope of the Union Pipeline Project involved the construction of a 24” pipeline tapped off from NGC’s 56” pipeline at Grant’s Trace, to bring gas onto the Union and LABIDCO Estates at La Brea. It included a pig launcher at Rousillac, a pig receiver at Union Estate and all necessary systems for separation, storage, gas metering and pressure regulation.

Once the HDD is complete, only minor works will be left to be done, such as the construction of a small workshop to allow NGC’s maintenance personnel to effect minor on-site repairs.

Energy Sector CSR Coordinating Task Force

With Corporate Social Responsibility (CSR) taking centre stage as a key activity within organizations, state-owned energy companies have created a task force, aptly named the Energy Sector CSR Coordinating Task Force, to develop common approaches and projects in their fenceline communities. Accordingly NGC, NEC, Petrotrin and Lake Asphalt in 2010 signed a Memorandum of Understanding which has been endorsed by the Honourable Minister of Energy and Energy Affairs. The MOU mandates the Task Force to maximize the positive socio-economic impacts of the sector, focusing on those communities that are in proximity to their operations and facilities and listed as being economically depressed.

The MOU mandates the Task Force to maximize the positive socio-economic impacts of the sector, focusing on those communities that are in proximity to their operations and facilities and listed as being economically depressed.

Objectives

- Coordinate Public Education programmes;
- Promote greater collaboration with regard to CSR programmes within the state-owned energy sector;
- Monitor CSR programmes within the sector and provide advice as appropriate.

Marine pipelaying activities

Strategies

- Capacity building and institutional strengthening of appropriate community groups in the sector's "fenceline" communities.
- Implementation of youth development programmes, via education, sport and culture.
- Building of strategic alliances with relevant organizations and agencies.

The Task Force recently established a partnership with the Ministry of National Security to assist Police Youth Clubs in "fenceline" communities. The Communities initially identified are Beetham, Siparia, La Brea and Couva.

Chairman of the Task Force Richard Brathwaite spoke recently at the launch of the Siparia Police Youth Club. He noted that "… the Energy Sector CSR Task Force will continue to work within our communities to promote meaningful and sustainable development.… We believe that the young people of Trinidad and Tobago are second to none and they are capable of great achievements. We do not accept that there is any lost generation, and even if it were so, then we have a duty to find them and ensure that they achieve their full potential. We are also convinced that all the resources that we need to transform our communities are readily available, but we need to establish closer collaboration among all stakeholders."

The Task Force recently established a partnership with the Ministry of National Security to assist Police Youth Clubs...

Tobago Pipeline On Stream

Work on the $1.4 billion natural gas project at the Cove Eco-Business and Industrial Park in southwest Tobago is expected to be completed by the end of November while the supply of gas to the $600 million electric power plant turbines will begin by the end of the year, according to NGC's Chairman, Larry Howai. The Tobago line has already been laid from the BHP Billiton offshore field to the Cove Estate where the gas receiving plant is in final stages of construction. The Trinidad and Tobago Electricity Commission (T&TEC) power plant is located close to the inlet facility.

NGC's Chairman, President and other officials met recently with officials of the Tobago House of Assembly (THA). Chief Secretary, Orville London said at the meeting he had discussed the possibility of gas being piped to hotels and homes in south-west Tobago. Mr. London also said a feasibility study would have to be undertaken.

Mr. London recalled that NGC was one of the largest corporate partners to support the development of Tobago over the years and quite apart from the technical contribution of the pipeline and inlet receiving facility, NGC had a long history of social programmes and projects in Tobago, namely a pavilion at Shaw Park, a multimillion contribution to the YMCA swimming pool at the Courland Heritage Park and the proposed pan theatre for the Dem Boys Steelband at Mason Hall.

Government to Encourage Local Melamine Production

Under the mandate of the Ministry of Energy and Energy Affairs, NEC is implementing a melamine initiative, through which it hopes to boost local manufacture of melamine-based products using local and foreign investment.

The melamine is being produced by MHTL at its AUM 1 plant on the Point Lisas Industrial Estate. Among the list of possible products are melamine moulding compounds, plastic tableware, paints, adhesives, plasticisers, laminates and coatings.

Melamine-based domestic production is expected to boost skilled and semi-skilled employment and lead to downstream development. As a low-investment initiative, it is a good fit for small light industrial and commercial entrepreneurs.

In support of NEC's aggressive promotion of melamine, Team Leader in the Office of the NEC President, Dr. Vernon Paltoo, made a presentation at the Trade and Investment Convention (TIC) at the Hyatt Regency Trinidad in June. Among the many inducements to melamine production Dr. Paltoo pointed out were the Government's willingness to provide the site, raw materials, utilities and infrastructure. The Union Industrial Estate has been identified as the site for these industries.

Construction work at the Galeota fish landing facility.

Melamine-based domestic production is expected to boost skilled and semi-skilled employment and lead to downstream development. As a low-investment initiative, it is a good fit for small light industrial and commercial entrepreneurs.

Paper laminating machine

While China continues to dominate the market, Mr. Paltoo sees great potential for successful penetration by Trinidad and Tobago. The former Minister of Energy and Energy Affairs, Carolyn Seepersad-Bachan, also launched the Melamine Business Profiles to investors and stakeholders present at the convention.

Galeota Fish Landing Facility

NEC is in the process of constructing a fish landing facility at Galeota to accommodate the heavy traffic of fisherfolk in the area. The facility currently under use is in extremely poor condition although fishing represents the second largest source of income in the community.

At the moment, infrastructural works such as coastal defence structures and retaining walls, the boat ramp and the fish unloading bay have been completed. The retail facilities, ice making area, boat repair sheds, and accommodation such as bathrooms and lockers are scheduled to commence. At the same time, construction of roads and other external works are being performed.

The design also incorporates a refuelling area, which will be operated by a local third party.

The agreement will see approximately eight acres of land being used for the construction of a new facility for the use of east coast operators such as bpTT, NGC, Repsol, BHP and BG, to facilitate the performance of logistics for shipping operations from Galeota.

Aerial view of the Galeota Port. *Google Maps Photo*

The facility is a modern, state-of-the-art structure planned and designed by foreign multinational Technital/Halcrow and is being constructed by GLF Construction Corporation. It meets all statutory requirements and has been subject to environmental and engineering audits.

This facility represents the largest single corporate social responsibility contribution being made in the Mayaro/Guayaguayare region, at a cost of TT$30 million. The contractor has advised that the facility will be completed by December, at which time it will be handed over to the relevant authority.

Galeota Port

Ownership of the lands on which the new Galeota Port is to be located has not yet been transferred from bpTT to the State, and thus work on the project has not yet begun. At present, the Land Management Division of the Ministry of Agriculture, Land and Marine Resources is attempting to expedite the land transfer. It is anticipated that this process will be completed before December.

The Galeota Port project is extremely significant in the context of supply chain logistics supporting exploration and production.

The agreement will see approximately eight acres of land being used for the construction of a new facility for the use of east coast operators such as bpTT, NGC, Repsol, BHP and BG, to facilitate the performance of logistics for shipping operations from Galeota. The land space will be augmented with reclamation that will add another eight acres. The new port will consist of five berths with a depth of 7.6 m (25 ft), which will greatly facilitate marine operations.

Designs were completed and have been reviewed and certified by international classification society Bureau Veritas. All foreign materials, such as piles, fenders, bollards and anchor wall materials have been delivered to the site. This will remove the lead time required for procurement once construction begins.

Associated with the port, a new 1.2 km access road, independent of the present access through bpTT, will also be constructed. All statutory approvals have been received and construction will be completed within 18 months. The Galeota Port project is extremely significant in the context of supply chain logistics supporting exploration and production.

The entire project is being managed by NEC.

Port of Brighton, La Brea

Brighton Port and Material Storage and Handling Facility Ready to Accept Tenants

NEC is seeking tenants for the Brighton Port and Material Storage Facility located at the La Brea Industrial Estate. Final works on the facility were completed in March 2011.

The development of the 8.5-hectare area had been earmarked for the cancelled Alutrint project, but was scaled down for general use by tenants. It includes three warehouses, an office building, customs bonded area, open storage areas, internal roads, drainage, a firefighting system, and all basic utilities such as lighting, sewage treatment system, potable water, data and telecom. All systems have been tested and commissioned. The port can accommodate one Panamax (not exceeding 50,000 dwt) vessel at the 307 m long dock at any time. The access channel and turning basin were dredged to a depth of -12.8 m chart datum, and the turning basin was widened to a diameter of 500 m.

The Honourable Minister of Energy and Energy Affairs, Kevin Ramnarine

T&T Has a New Energy Minister

Former Parliamentary Secretary Kevin Ramnarine was appointed to the post of Minister of Energy and Energy Affairs in June. Within his first month in the position he met with all five Chairmen of the State Boards within his purview, as well as staff within his Ministry. He intends first to focus on people issues within the Ministry, particularly those involving younger members of staff, as he sees them as the next generation of industry leaders. As far as the energy industry is concerned, he will make it his priority to increase oil production at Petrotrin, and to seek more foreign direct investment in Trinidad's energy sector.

Prior to his appointment, Mr. Ramnarine was the parliamentary representative in the Ministry of Energy and Energy Affairs and an economist at BG Trinidad and Tobago. He holds academic qualifications in Petroleum Engineering and Management. He has also been a part-time lecturer in the International MBA programme at the Arthur Lok Jack Graduate School of Business, and an Energy Specialist at the Energy Chamber.

Former Minister of Energy and Energy Affairs Carolyn Seepersad-Bachan has taken over the Public Administration portfolio.

Natural gas pipeline Configuration.

IEA Predicts New "Golden Age" for Gas

The International Energy Agency expects an upturn in the prospects for the natural gas industry, according to its Special Report entitled *World Energy Outlook 2011.* Among the factors that suggest natural gas will play a greater role in the energy mix are mounting environmental concerns regarding less clean-burning fuels, such as oil and coal. Increasing urbanization in China, India and the Middle East is also a hopeful sign, as the accompanying growth in energy demand provides an opportunity for greater natural gas consumption.

Unconventional natural gas resources are on the rise. Unconventional use now comprises 60% of marketed production in the US, and coalbed methane (CBM) development is increasing in Australia. There are also projects in China, India and Indonesia under development. In spite of the environmental concerns associated with shale gas use, there is confidence that proper implementation

of best practices will mitigate against the slightly higher emission rate through limited water consumption and reduced contamination and disposal.

Growth within the nuclear industry has slowed. With the blow suffered by Japan's nuclear industry following the recent earthquake and tsunami, and Germany's decision to phase out nuclear energy production, the demand for alternative forms of energy is likely to increase.

The attractive price of natural gas relative to that of other fuels is also a factor in its growing demand worldwide.

T&T Rated Baa1 by Moody's

Upon releasing its annual sovereign report on Trinidad and Tobago, Moody's has confirmed the country's rating of Baa1 based on the country's relatively high economic development, stable outlook, low government debt, solid external position and institutional framework.

In light of this positive rating, Trade and Industry Minister Stephen Cadiz confirmed Government's intention to implement its stringent economic policies to ensure the country's recovery from the recent economic downturn and to offset factors cited as areas for concern, namely the recent trajectory of fiscal and debt metrics.

The report also pointed to the strong support for T&T's fiscal savings mechanisms, which have led to savings of 18% of GDP.

Energy-related products such as natural gas, methanol, ammonia and urea continue to dominate Trinidad and Tobago's exports. The strong energy sector has led to a per capita GDP that is almost double the median of Baa sovereigns. T&T's real GDP growth rate was estimated at 0.1% in 2010 and is projected at 2% for 2011.

Exporting natural gas to the rest of the Caribbean is of particular interest to Trinidad and Tobago as gas prices have been declining, especially in the US where reliance on shale gas has increased.

Government Continues to Seek Downstream Investors

Technical adviser to the Minister of Energy and Energy Affairs and former NGC President, Mr. Frank Look Kin, has expressed the Government's intent to continue seeking investors for downstream investment in the energy sector.

According to Mr. Look Kin, interested bidders have been asked to provide details about their intended projects, including scope of works, financing, required inputs, technology, requirements for utilities, infrastructure, land and manpower, natural gas demand and eventual product. The financing, he pointed out, was particularly important, as in the past many good projects were stillborn due to a lack of financing.

The environmental impact of proposed projects will also be of major importance, and potential investors will need to explain in detail the expected environmental impacts of their projects and how they intend to mitigate against them.

Finally, investors using new energy-efficient technology will have the advantage, as their methods will present a greater output for the gas used. The Ministry is particularly interested in the possibility of taking petrochemicals produced in Trinidad (such as ammonia and methanol) further downstream, resulting in greater employment opportunities and more national development.

UWI Cave Hill in Joint Pact for Biofuel Research

As the search for cheaper, environmentally responsible, alternative fuel continues, the University of the West Indies at Cave Hill has entered into a research and commercial agreement with BioJet International Limited to explore the production of biofuels.

BioJet International is an international supply chain integrator for products such as renewable jet fuel and others relating to the transportation and aviation industries – including renewable jet fuel, "green" diesel, feedstock oil and feedstock co-products.

Under the terms of the agreement, the UWI/BioJet International Biofuel Research Institute will be created. BioJet will finance research taking place at UWI for the development and commercialization of biofuels and other forms of renewable energy. There will also be the sharing of intellectual property outcomes from research into microalgae for the production of biofuels and derivatives.

The project will open up prospects for the commercialization of intellectual property at the institution, as well as open the way for future careers in the alternative energy industry.

one moment please

to reflect on the beauty that surrounds us here in Trinidad and Tobago

The long stretch of Manzanilla-Mayaro beach is remarkable for the abundance of coconut trees lining the surf-drenched shores. As one drives along the road which runs parallel to the shore, the palm trees waving in the Atlantic Ocean breezes are testimony to the plantation days when coconut harvests sustained families on the east coast of Trinidad. At one point in the area called Cocos Bay, the Nariva River empties into the sea. *Photo by Dwight Lake*

THE NATIONAL GAS COMPANY
OF TRINIDAD AND TOBAGO LIMITED

Orinoco Drive
Point Lisas Industrial Estate, Couva
Republic of Trinidad and Tobago, W.I.
P. O. Box 1127, Port of Spain
Tel: (868) 636-4662, 4680
Fax: (868) 679-2384
Email: info@ngc.co.tt
Website: www.ngc.co.tt