THE NATURAL GAS INDUSTRY IN TRINIDAD AND TOBAGO

by

Richard Jobity and Robert Pantor
Central Bank of Trinidad and Tobago

July 1995

THE NATURAL GAS INDUSTRY IN TRINIDAD AND TOBAGO

Richard Jobity and Robert Pantor

Formerly seen as a useless by-product in the search for oil, natural gas is now seen as the fuel of the future. While oil maintains the backbone of the Trinidad and Tobago economy, gas has assumed an important role over the last two decades. Natural gas is now the principal feedstock used in electricity generation and provides the base for downstream petrochemical industries. Over the next decade, natural gas will supersede petroleum as the driving force behind the Trinidad and Tobago economy. This paper attempts to describe and analyse the natural gas industry in Trinidad and Tobago, with particular emphasis on markets, gas pricing and legal issues, and concludes with the future outlook for the Trinidad and Tobago gas industry.

THE NATURAL GAS INDUSTRY IN TRINIDAD AND TOBAGO

Richard Jobity and Robert Pantor *

I. INTRODUCTION

For several reasons, natural gas is yet to attain the same high status globally as petroleum. The problems associated with transportation and storage of natural gas has restricted both the usage and the quantum of inter-regional trade in the commodity. In addition, the world's concentration on crude oil resulted in many natural gas deposits being flared or abandoned as uneconomic. However, developments in shipping and progress in the production of liquefied natural gas (LNG), has increased interest in gas. Moreover, it is the politically correct choice in countries where environmental concerns and energy security are dominant themes.

Over the past two decades, natural gas has assumed an increasingly important role in the Trinidad and Tobago economy. Natural gas provides the base (fuel and feedstock) for downstream petrochemicals and heavy industry including ammonia, urea, methanol, natural gas liquids, iron and steel and iron carbide. In addition, gas has been the principal fuel used in electricity generation since the mid-1960s. As a result, the market share of natural gas in Trinidad and Tobago's energy supply rose from 57 per cent in 1975 to 84 per cent by 1994. Similarly, the share of gas-based industries in exports increased from 2.7 per cent in 1975 to 36.4 per cent in 1994. This trend will continue in the medium term as the country seeks to monetize its reserves of natural gas to offset reduced revenue from the petroleum sector. The discovery of new gas fields, the development of reserves and setting up of additional gas-using industries such as LNG and iron carbide, will help to offset the long term decline in oil production. As a result, the natural gas industry is poised to supersede petroleum as the driving force of the Trinidad and Tobago economy.

However, within the country there is no universal agreement on exactly what constitutes the natural gas industry. Several definitions are used to define the gas industry, depending on the agency involved. For instance, the Central Statistical Office (CSO) utilizes the Trinidad and Tobago System of National Accounts (TTSNA) value-added approach which narrows the industry to incremental input related solely to gas production. In its estimation of the Quarterly Real GDP (QGDP), the Central Bank of Trinidad and Tobago employs a similar approach but assigns a proportionately larger weight to petrochemicals manufactured from gas. In contrast, the National Gas Company applies a more holistic approach encompassing the range of gas-based activities from the wellhead to the export flange. This paper utilizes the latter approach.

This paper is an attempt to analyze the natural gas industry in Trinidad and Tobago. The paper contains five sections. Section II provides a general overview of the commodity and the history of the industry, while Section III outlines the characteristics of the gas

* The authors are Economists in the Research Department of the Central Bank of Trinidad and Tobago. Views expressed are those of the authors and not necessarily those of the Central Bank of Trinidad and Tobago. This paper is extracted from the forthcoming paper "The International Market for Natural Gas" by the authors.

industry in Trinidad and Tobago. Section IV summarizes natural gas pricing and taxation issues while Section V concludes the paper with projections for the future.

II OVERVIEW

2.1 Physical Properties

Natural gas is a mixture of naturally occurring gaseous and highly flammable hydrocarbon compounds present in underground reservoirs. It is recoverable as gas in atmospheric surface conditions and can exist in any one of three states. Natural gas present in a reservoir may be dissolved in petroleum; alternatively, it occurs in conjunction with crude oil but compressed in a geological formation known as a gas cap. In both cases, the gas is 'associated' with oil. Gas can also be present in a predominantly gaseous form, but with other hydrocarbons apart from methane, the main constituent of gas. When this occurs it is classified as non-associated or 'wet' gas. However, when the primary compound present in the gas is methane, it is known as non-associated or 'dry' gas. In most cases, natural gas occurs in association with condensate (liquid hydrocarbons sometimes found in natural gas reservoirs) or with other hydrocarbons such as butane, propane and ethane.

2.2 Chemical Properties

The major hydrocarbon present in natural gas is methane, a colourless and odourless gas. Other components of natural gas include nitrogen, carbon dioxide, hydrogen sulphide and water. Natural gas usually contains paraffinic compounds distinct from methane such as ethane, propane, butane, pentane and other heavy hydrocarbons. Though methane is an odourless gas, associated elements present in natural gas may result in a distinctive odour. For example, the presence of hydrogen sulphide can impart a sulphuric odour to natural gas. Table 2(a) shows some chemical properties of the hydrocarbons present in natural gas.

Despite these similarities, in its innate state natural gas is not a homogenous commodity. The proportions of the hydrocarbons present in natural gas differ from field to field, depending on the level of exploitation and age of the field. The proportion of paraffinic hydrocarbons determines the overall calorific value of the natural gas and ultimately the end value of the gas. This is illustrated in Table 2(b).

TABLE 2(a)

PARAFFINIC HYDROCARBONS IN NATURAL GAS

Name	Chemical formula	Boiling point at atmospheric pressure (°C)	Condition at normal temperature and pressure
Methane	CH_4	-161.5	Gaseous
Ethane	C_2H_6	-88.6	Gaseous
Propane	C_3H_8	-42.1	Gaseous
Isobutane	C_4H_{10}	-11.7	Gaseous
Normal Butane	C_4H_{10}	-0.5	Gaseous
Isopentane	C_5H_{12}	27.9	Liquid
Normal Pentane	C_5H_{12}	36.1	Liquid
Normal Hexane	C_6H_{14}	68.7	Liquid
Normal Heptane	C_7H_{16}	98.4	Liquid
Normal Octane	C_8H_{18}	125.7	Liquid

Source: The Petroleum Handbook, Royal Dutch/Shell Group of Companies, 1983

TABLE 2(b)

CONSTITUENTS OF NATURAL GAS FROM SELECTED AREAS

Percentage of total volume[1]

CONSTITUENT	Algeria	Libya	Brunei	North Sea (Ekofisk)	Iran	Netherlands (Groniges)	Alaska	TRINIDAD AND TOBAGO		
								East Coast Associated Gas	East Coast 'wet' gas	North Coast 'Dry' Gas
Methane	86.3	66.8	88.0	85.9	96.3	81.3	99.5	89.7	92.6	99.4
Ethane	7.8	19.4	5.1	8.1	1.2	2.9	0.9	4.0	4.3	0.2
Propane	3.2	9.1	4.8	2.7	0.4	0.5	0.0	2.1	1.5	0.1
Butane	0.6	3.5	1.8	0.9	0.2	0.1	0.0	1.2	0.7	0.0
Pentanes and others	0.1	1.2	0.2	0.3	0.1	0.1	0.0	0.9	0.4	0.0
Nitrogen	0.0	0.0	0.1	0.5	1.3	14.4	0.4	0.3	0.1	0.2
Carbon Dioxide	0.0	0.0	0.0	1.0	0.0	0.9	0.0	1.8	0.4	0.1
Gross Calorific Value (Kilojoules/m^3)	42,667.7	53,054.8	43,064.6	41,953.2	37,547.6	32,943.4	37,190.3	41,239.0	38,220.0	37,669.0

Sources: Blue Gold: The Political Economy of Natural Gas, J.D. Davis, 1981;

Trinidad and Tobago, White Paper on Natural Gas, 1981;

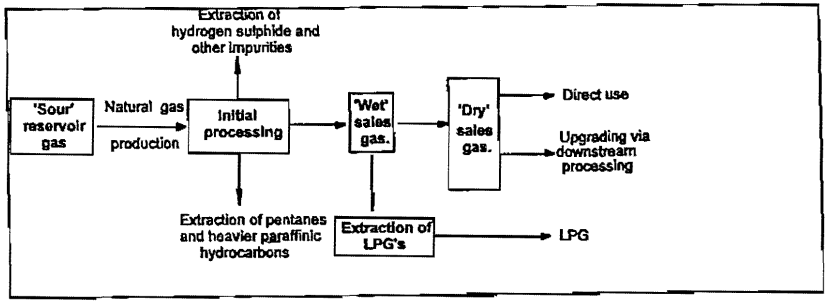
Trinidad and Tobago, Natural Gas in Trinidad and Tobago; An investor's Guide, 1985.

[1] Totals may not add due to rounding.

The versatility of natural gas regarding its proven applicability in direct and downstream utilization has confirmed its status as the prince of hydrocarbons. For downstream gas users, the removal of impurities such as sulphur that results in lower efficiency forms part of the overall processing sequence. In cases where natural gas contains pentanes and other naturally condensing hydrocarbons, these compounds, which have value in themselves, can be removed from the natural gas stream. The resulting dry 'sales' gas can be utilized directly or upgraded via downstream processing. Figure 1 shows a simplified diagram of this process.

FIG. 2(i)

TYPICAL PROCESSING OF NATURAL GAS



Source: 'Gas Resources, Development and Utilization', Richard Hymas, 1992.

2.3 Uses of Natural Gas

In Trinidad and Tobago, the natural gas reserves exploited contain no sulphur and consequently need less processing than in other regions. Via liquids' recovery, the processed natural gas is much 'drier' and thus more suitable for downstream use. Table 2(c) shows the difference made by extraction of medium and heavy paraffins, while Figure 2(ii) outlines the overall processing of natural gas in Trinidad and Tobago.

TABLE 2(c)

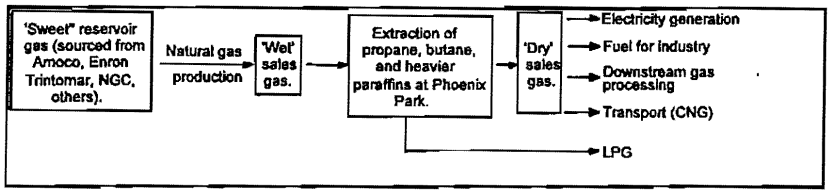
EFFECT OF PROCESSING NATURAL GAS BY NATURAL GAS LIQUIDS RECOVERY IN TRINIDAD AND TOBAGO

CONSTITUENT	Typical composition of inlet gas (mole %)	Typical composition of outlet (residual) gas (mole %)
Methane	93.7	95.9
Ethane	3.3	3.3
Propane	1.2	0.0
Butane	0.6	0.0
Pentanes and others	0.5	0.0
Nitrogen	0.1	0.1
Carbon Dioxide	0.7	0.6

SOURCE: Phoenix Park Gas Processors Limited.

FIG. 2(ii)

Processing of Natural Gas in Trinidad and Tobago



SOURCE: Adapted from Hymas (1992).

Processed natural gas is utilized in two ways: by direct use in captive markets, and in the manufacture of downstream gas derivatives for export. Direct utilization of natural gas occurs in four ways:

Power Generation - The conversion of natural gas to electricity remains one of the most attractive options open to developing countries for using this resource. However, this requires large initial investments in capital equipment. Due to the limited funds available to the private sector in developing countries, most investments in generating capacity remain the domain of the public sector. However, for such investments to be profitable, forecasts of demand growth must be high enough to ensure optimal operating capacity.

Domestic Fuel - In areas of abundant supply and low-cost, natural gas is a low cost alternative fuel for heating and cooking. This can take the form of piped gas, as occurs in Mexico, or bottled LPG in areas where logistical problems preclude the establishment of a pipeline network, as is the case in Trinidad and Tobago.

Industrial Use - Another option for using gas is as energy, either as raw material feedstock or as a fuel for generation of low-cost electricity. The additional value created through industrial use of gas derives from domestic and imported raw materials. For instance, following the establishment of a minimill at Point Lisas in 1980, Trinidad and Tobago used its gas as fuel to process imported iron ore into direct reduced iron, billets and wire rods.

Automotive Use – The escalation in oil prices over the past two decades led to greater interest in natural gas as an automotive fuel in the form of compressed natural gas (CNG) and liquefied petroleum gas (LPG) especially among oil importers. In areas where reserves are abundant, or where travel distances are short, natural gas can provide a cost-effective alternative to gasoline.

The downstream processing of natural gas is vastly different from domestic use. Major features of downstream industries include worldscale plants and significant foreign exchange earning potential. However, in developing countries, downstream gas industries usually operate as enclaves divorced from the rest of the economy. As such, benefits in the form of enhanced employment opportunities and import substitution remain minimal. Downstream uses include:

Liquefied Natural Gas (LNG) -- The most profitable use for natural gas is its liquefaction and subsequent export as LNG. Prior to an investment decision, project sponsors must address several issues. These include the location of reserves to support an LNG facility, the feasibility of gas liquefaction and long-term contracts and markets.

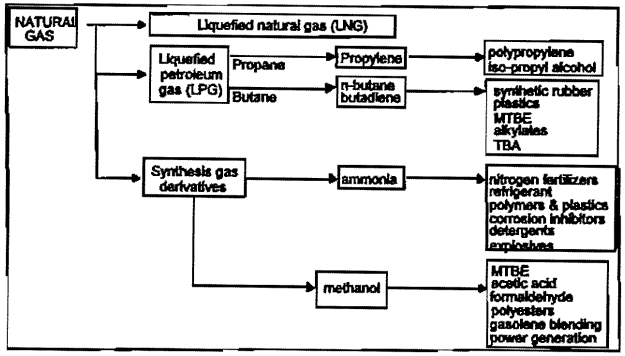
Liquefied Petroleum Gas (LPG) - The presence of heavier paraffinic compounds in natural gas enhances its value. The major products traded include propane, butane and derivative products. Downstream uses for propane include the manufacture of propylene via the dehydrogenation process. Polypropylene, a principal raw material in the plastics' industry is the major derivative of propylene. Butane, as a finished product or dehydrogenated into n-butanes and butadiene, remains essential to the manufacture of synthetic rubber and plastics. It also provides the base for petrochemicals used to increase the octane rating of gasoline. These include methyl tertiary butyl ether (MTBE) and tertiary butyl alcohol (TBA).

Synthesis Gas Derivatives - The majority of natural gas processing globally takes the form of the production of synthesis gas. This involves the decomposition of methane to carbon oxides and hydrogen by steam reaction and the subsequent production of derivative products. Ammonia, the basis for all nitrogen fertilizers, is the most widespread synthesis gas derivative created by this process. The other major derivative obtained from this reaction is methanol, used directly and downstream in the production of MTBE, formaldehyde, and acetic acid.[1] Figure 3 gives a diagrammatic representation of the downstream uses of natural gas.

[1] Further information on the ammonia and methanol markets and industries can be found in the papers *'The International Nitrogen Fertilizer Industry: A Profile of Ammonia and Urea'*, by Richard Jobity, Central Bank of Trinidad and Tobago, mimeo, 1993; and *'The International Methanol Market'*, Robert Pantor, Central Bank of Trinidad and Tobago, mimeo, 1993. As a result, these commodities will not be discussed in detail in this paper.

FIG. 2(iii)

DOWNSTREAM PROCESSING OF NATURAL GAS



SOURCE: Adapted from Hymas (1992).

2.4 History of the Natural Gas Industry in Trinidad and Tobago

The presence of asphalt at the Pitch Lake in La Brea provided the impetus for exploiting hydrocarbon reserves in Trinidad and Tobago. In 1595, Sir Walter Raleigh used the asphalt from the lake to caulk his ships, commenting favorably on the high quality of the pitch. Notwithstanding this development, natural gas did not achieve significance until the first half of the twentieth century. Like many other countries, attempts at using natural gas in Trinidad and Tobago commenced with the extraction of the gas component from other hydrocarbons: in this case, asphalt sourced from the Pitch Lake. At the request of the then governor Sir Ralph Woodford, gas was extracted from asphalt for illuminating "... a beacon placed in the tower of Trinity church". Although the resultant gas created by this process "... burnt brightly and steadily...", the intolerable smell of the sulphur in the gas rendered the

experiment a failure. Eventually, an American scientist was successful in extracting odour-free gas from Trinidadian asphalt. However, the high costs incurred in extracting the gas made the process uneconomic.

The first attempt to find hydrocarbon reserves in Trinidad and Tobago proved unsuccessful.[2] Between 1858 and 1860, a detailed geological survey of Trinidad and Tobago was carried out as part of a wider survey of the British West Indies.[3] The ensuing Wall and Sawkins report although inconclusive regarding petroleum deposits intimated the existence of several natural gas fields in southern Trinidad.[4]

Despite the inconclusive findings of the Wall and Sawkins report, Walter Darwent remained convinced that petroleum deposits existed in Trinidad based on the analysis of mud volcanoes in the Cedros area and cuttings at Aripero. Despite opposition by Wall and Conrad Stollemeyer, a prominent landowner, Darwent and the Paria Oil Company drilled for petroleum at Aripero in 1866. Oil and gas were discovered when the well was tested in January 1867. However, cash flow problems among the investors led to the failure of the venture. Between 1901 and 1907 drilling at Guayaguayare, San Fernando, La Brea and Point Fortin also detected oil and natural gas. Furthermore, a systematic search for oil and gas in Trinidad and Tobago by oil-field engineer A. Beeby-Thompson confirmed the presence of natural gas on land and hinted at the existence of natural gas reserves offshore. From 1907, a programme of large scale drilling commenced in the Point Fortin area, later spreading to Tabaquite, Fyzabad, Siparia, and other southern areas. The first cargo of oil (3,800 tons) was exported from La Brea in 1911.

In the years immediately preceding World War I, British concerns over the security of fuel oil supply led to the formation of Trinidad Oilfields Limited. This company commenced mining operations in the Guapo district.[5] The purpose of British involvement at that time was to make Trinidad the principal source of bunker fuel in the Western Hemisphere for the British Royal Navy. By 1912, twelve other private oil companies had begun petroleum operations in Trinidad, with thirty others being registered. Major obstacles to the exploitation of petroleum included remote areas, nonexistent infrastructure, shortage of capital, lack of trained staff, unsanitary health conditions and complex geological structures. Notwithstanding these problems, prolific sources of oil (and gas) opened up in Tabaquite, Barrackpore and Forest Reserve by the outbreak of World War I in 1914. The colony remained the largest source of petroleum under British control worldwide until exceeded by British Borneo in 1949.

Early leases treated natural gas as a valid byproduct of oil, with a specific market value. According to a 50-year oil lease agreement granted in January 1914 between Trinidad Leaseholds Limited and the Crown concerning the exploitation of oil and gas concessions on Crown lands, the royalties for gas were '1d. per 1,000 cubic feet of natural gas' (absolute pressure of 1 atmosphere, temperature of 60°F).[6] In addition, all crude oil, natural gas and

[2] In 1857, the Merrimac Company drilled one non-commercial well in the vicinity of the Pitch Lake, La Brea.
[3] C. P. Wall and J. G. Sawkins, *'Report of the Geology of Trinidad and Tobago or Part 1 of the West Indian Survey'*. H. M. Stationary Office, 1860.
[4] In fact, the report described in detail the presence of natural gas, mud volcanoes and naturally occuuring asphalt, later proved as fairly reliable indicators of the presence of petroleum.

[5] At the time, the only oilfields of any significance outside the United States and Russia were in Romania, the East Indies and Galica - none under direct British control.
[6] The basis for fixing the royalties at that amount was the philosophy that royalty payments should approximate ten per cent of the market value of the product. Even though the philosophy applied explicitly to crude oil, it

'other bituminous material' used by the lessees were exempted from royalty.' This type of lease was typical, since the presence of natural gas remained incidental to the major concern of the lessee - producing oil. Gas injection as a method of crude oil production, although patented in the United States in 1864, was not yet introduced into Trinidad and Tobago. Nevertheless, the British government recognized the value of natural gas and the charging of royalties on gas represented the first attempt to quantify this resource. In 1924, a new model for oil leases was adopted by the colonial government. Royalties on crude were increased from 2s. to 3s. per ton and natural gas from 1d. to 2d. per thousand cubic feet. Despite this increase, however, royalty rates in Trinidad remained among the most lenient in the world.

Between World Wars I and II, the oil and gas industry in Trinidad was marked by steady growth and the consolidation of assets. Operating companies with a strong financial base, such as Trinidad Leaseholds Ltd., which operated in the Forest Reserve and Guayaguayare area, and Apex Trinidad Oilfields (based in Fyzabad) became dominant forces in the industry. From 1932 onward, growing awareness of the importance of natural gas to oil production led to greater conservation and efficient usage. One year later, oil recovery rates improved following the introduction of gas injection in the Forest Reserve area.

In the early 1940s, the Penal area, traditionally regarded as an oil zone, was the site of the discovery of the country's first large dry natural gas deposit on land. By 1955, the first offshore deposit, located 19 miles southwest of Port of Spain was discovered. Other gas zones discovered during the period included the Mahaica dry gas field, and the Soldado

implies that natural gas was valued at 10 d. per thousand cubic feet - more than is paid as royalty in some concessions at present.

associated gas fields. However, it was not until the late 1950's that commercial natural gas usage began in Trinidad. The American multinational W. R. Grace established the Federation Chemicals Limited (FEDCHEM), plant at Savonetta in 1958. This marked the country's initial attempt to use natural gas in non-oil industry; specifically, the manufacture of nitrogen fertilizers. Fertilizer production commenced in 1959 with the establishment of three small units producing ammonia, urea and ammonium sulphate. The plants used associated natural gas from the oil fields, with output from the plants geared towards the local, Caribbean and metropolitan markets of the U.S.A. and the United Kingdom. Grace later expanded production in 1964 and 1966 with the addition of two new ammonia plants and urea production facilities. One of the latter plants is still in operation.

In the early 1960s, exploration for hydrocarbons commenced off the east coast of Trinidad and Tobago. Between 1961 and 1968, offshore leases were granted, seismic work done and exploration carried out. Initial efforts, however, were fruitless. Meanwhile, gas production on land increased to such an extent that Shell Trinidad Limited, backers of some of the earliest oil operators operating in Trinidad, were able to enter into a long-term contract with the Trinidad and Tobago Electricity Commission (T&TEC). Under the terms of the contract, Shell agreed to supply natural gas to T&TEC at a rate of TT $0.10 per thousand cubic feet. The royalty paid by Shell under the terms of the production license was TT $0.015 per mmcf.

From 1968 onwards gas production and use took off. Amoco's discovery of a large deep gas condensate field in the Offshore Point Radix (OPR-2) exploratory well marked the first gas find off the east coast of Trinidad (the Atlantic Province) - later to become the most

prolific gas source in the country. Later that year, the company found the South East Galeota, or Cassia gas field in the same province. Three years later, exploratory drilling began off the north coast of Trinidad, resulting in the detection of substantial deposits of natural gas. To date, these gas deposits remain unexploited.

By 1974, increased gas usage in the power generation sector, along with planned investments in downstream industries using gas as a feedstock required the expansion of the existing offshore gas pipeline system. The Government of Trinidad and Tobago built a 16" 26 mile offshore gas pipeline, project-managed by Amoco. During the same year, Amoco and the government signed a supply contract regarding T&TEC's gas requirements for electricity generation. This contract replaced the Shell agreement, originally signed in 1962.

By 1975, the growing importance of natural gas in the national economy necessitated some rationalization of the transmission sub-sector. Prior to this period, sales and transmission of natural gas were completely deregulated. Individual producing companies sold gas to consumers on a case-by-case basis, e.g., the original Shell gas supply contract with the government. Producing companies also owned the gas transmission pipelines. In 1975, the Government created a State agency with a mandate to be the sole buyer, seller, transmitter and distributor of natural gas throughout Trinidad and Tobago - the National Gas Company of Trinidad and Tobago (NGC).

Three years earlier, W.R. Grace conceived the idea of entering into a fertilizer joint venture with the government as a mean of monetizing the extensive gas reserves discovered in Trinidad between 1968 and 1971. However, it was not until 1974 that the State became directly involved in the local downstream petrochemical industry, with the incorporation of Trinidad Nitrogen Company (TRINGEN), a joint venture between the State (51 per cent) and Grace (49 per cent). Construction of the plant began in 1975, with completion and commissioning two years later. The TRINGEN plant used natural gas purchased from the NGC as feedstock and had an annual rated capacity of 360,000 metric tonnes of anhydrous ammonia, with all production being exported to the U.S.A. This plant came on stream in time to replace a FEDCHEM fertilizer plant that originally began production in 1959. The latter plant closed permanently in 1978. Ten years later, the second Tringen plant started operations.

Further investments were made in the natural gas industry by the State and State-owned agencies, including one unsuccessful attempt at exporting natural gas as LNG to the US market[7]. In 1977, the government built a 24" 40 mile gas pipeline from the Amoco Teak platform via the offshore Poui field to Picton in southwest Trinidad. Six years later, the NGC commissioned two new 30" pipelines spanning 40 miles each: an offshore gas pipeline from the Cassia field to Galeota and a cross-country gas pipeline from Mayaro to Point Lisas. This followed projections of increased gas demand by proposed downstream users, including fertilizers, iron and steel and electricity generation.

[7] The project involved a consortium of interests: the producers (Amoco, with its reserves off the east coast; the South East Coast Consortium, with its potentially lucrative discoveries in the reverse 'L' block; and Deminex/ Agip/ Tenneco and Occidental, the holders of the license for the North Coast fields), the pipeline transport (the NGC), the shareholders in the liquefaction plant (Tenneco, Midcon and the government), the LNG shipping company (the government, Tenneco and Midcon) and the regasification plant (Tenneco and Midcon). However, the project eventually fell through due to prohibitively high cost

Between 1980 and 1988, three ammonia plants and one urea plant were built. In 1978, a joint venture between the government of Trinidad and Tobago (51 per cent) and Amoco International Oil Company (49 per cent) established Fertilizers of Trinidad and Tobago Limited (FERTRIN) to produce anhydrous ammonia. FERTRIN purchased two ammonia plants (previously engineered for American and Canadian companies) in the same year and erected the plants at Point Lisas between 1978 and 1981. The decision of the government to get involved in urea production via the Trinidad and Tobago Urea Company (TTUC) came two years after the oil shock of 1979. One year later, a worldscale gas-fired steel mini-mill, the Iron and Steel Company of Trinidad and Tobago Ltd. (ISCOTT) commenced operations at the Point Lisas Industrial Estate, utilizing 29 mmcf/d of natural gas. In 1984, new methanol facilities came on stream, requiring 35 mmcf/d of gas.

The NGC gradually became more involved in upstream gas activities. The company's first foray into gas production came in 1981 with the commissioning of two offshore platforms to collect low pressure associated gas from Amoco's Teak and Poui fields. The company also acquired a 20 per cent share in Trintomar, a consortium of State-owned industries assembled for exploiting acreage leased to the South East Coast Consortium (SECC). In 1989, the NGC concluded a joint venture agreement leading to the creation of Phoenix Park Gas Processors Ltd., a liquefaction facility. The NGC holds a 49 per cent interest in the company. Four years later, the NGC's expanded mandate included responsibility for all gas-based investment in Trinidad and Tobago following the dissolution of the National Energy Corporation (NEC).

However, the most ambitious attempt by any local group to date to invest in upstream facilities ended in failure. On the basis of seismic and geological data, the Trintomar shareholders obtained a loan of US $120 million from Japanese financiers Nissho Iwai for the building of a natural gas platform and the establishment of related infrastructure. The decision to drill based on the results of one exploratory and one appraisal well proved a major blunder. Inadequate seismic and geological data led to poor reservoir analysis and over-estimation of the Pelican gas reserves. Moreover, the decision to site the platform neither over nor near the site of the original Pelican discovery resulted in the first well striking water rather than gas. Finally, the blowout and subsequent financial problems brought the viability of the project into question. Despite these set-backs, work continued on the Pelican field until mid-1992 when drilling activity ceased. At present the platform is used primarily as a gas compression facility by Enron Gas and Oil Trinidad Limited (Enron).

The blowout of the Pelican platform precipitated a gas supply dilemma for the State, resulting in several shifts in national gas policy. Following the Trintomar experience, the State refused to entertain additional direct investments in upstream activity due to the high-risk nature of these ventures. The NGC also took steps to secure existing sources of gas supply. In the fourth quarter of 1991, the NGC and Amoco entered into a new 20-year gas contract to replace the previous contract (due to expire in 1999), which will expire in the year 2011. Under the terms of the agreement, Amoco pledged to deliver incrementally increasing amounts of gas from 1992 to 1996. The company also developed two new fields, the Flambouyant and the Immortelle as part of their commitment to the NGC contract.

The State also attempted to diversify gas supply sources. Towards this end, the government concluded an agreement with Enron in 1992 for development of unutilized SECC acreage. In return for a 95 per cent working interest, Enron pledged an investment of US $250 million over a 5-year period to develop the SECC's acreage, excluding the Pelican field. Infrastructure work involving the laying of transmission pipelines and erection of the gas platform in the Kiskadee field commenced in September 1992, with gas production from this field commencing in the fourth quarter of 1993. Further, in September 1993 the Government, in conjunction with a joint venture between British Gas, plc and Texaco, signed agreements to permit the development of natural gas reserves in the Dolphin Field. The accord involves an initial investment of US $140 million for updating seismic data, laying of pipelines, installation of a gas and condensate platform and start-up of drilling activity. These agreements, together with a 20 year natural gas supply contract with NGC will facilitate delivery of gas from this field by 1996.

Several new gas projects are currently in various stages of execution. In addition to the Texaco and British Gas Dolphin investment, the NGC, along with three foreign partners is investigating the feasibility of an export LNG plant in Trinidad. The proposed facility will have a rated capacity of 425 mmcf/d and will cost approximately US $1,200 million dollars. The designated site is the planned Brighton/La Brea industrial estate in south Trinidad.

In the downstream steel sector, the US firm Nucor obtained a technology license from Iron Carbide Holdings Ltd. for construction of an iron carbide plant. The facility represents the first attempt to produce this commodity on a commercial basis. The capacity of the proposed installation is 320,000 tonnes per annum at an estimated cost of US $75 million. The plant is now mechanically complete following eighteen months of construction. Minor technical problems delayed commercial shipments to Nucor's steel mills in the US. If the initial facility is commercially viable, Nucor intends to build three (3) additional iron carbide plants in Trinidad and Tobago.

III. THE MARKET FOR NATURAL GAS

3.1 The International Market

In marked contrast to crude oil and despite the commodity being internationally traded, there is no 'global' market for natural gas. The 'market' comprises several distinct and separate sub-markets, each with its own sources of supply and pricing policy. For example, the market for natural gas in Western Europe (excluding the UK) consists of pipeline gas sourced from both indigenous and imported sources as well as LNG. The geographical exclusivity of the international natural gas industry has resulted in distinct paradigms of market structure and competitive behaviour. The nature of the market and the extent of competition depend largely on the influence of institutional and regulatory factors. National and regional gas markets range from monopolistic competition in the United States, and Canada to the institutional monopolies of Trinidad and Tobago and the United Kingdom.

Over the past decade natural gas, unlike crude oil, has displayed consistent increases in both production and consumption. Gas production (excluding flared and recycled gas) increased from 1,334.1 million tonnes of oil equivalent (mtoe) in 1983 to 1,888.4 mtoe in

1993. Similarly consumption of natural gas rose consistently from 1,330.0 mtoe in 1983 to 1,787.1 mtoe ten years later. Table 3 (a) shows this trend.

Another characteristic of the natural gas market is the relatively low realized value for gas given the volume of trade. The high volumes of gas needed to drive industrial and domestic uses preclude the option of gas storage - at least in its natural state[8]. As a result, historical patterns of gas usage worldwide coincided with areas of production. Changes in refrigeration and pipeline technology facilitated the use of gas in areas far removed from sources of production.

TABLE 3(a)

GLOBAL PRODUCTION AND CONSUMPTION OF NATURAL GAS: 1983-1993

YEAR	Production	Consumption (mtoe)	Difference (mtoe)[9]
1983	1,334.1	1,330.0	4.1
1984	1,452.5	1,433.8	18.7
1985	1,506.0	1,478.6	27.4
1986	1,551.9	1,483.6	68.3
1987	1,634.5	1,562.6	71.9
1988	1,703.5	1,638.5	65.0
1989	1,766.1	1,712.9	53.2
1990	1,813.3	1,759.8	53.5
1991	1,837.6	1,772.6	65.0
1992	1,849.2	1,759.3	89.9
1993	1,888.4	1,787.1	101.3

Source: BP Statistical Review of World Energy (1994).

[8] In energy-deficient areas, where the prohibitive cost of alternative sources of energy make the long-distance transmission of natural gas feasible, storage and transportation concerns are alleviated by the use of liquefied natural gas (LNG). However, the LNG must be priced at a level to ensure project viability - usually at least twice the cost of pipeline transmission of natural gas.

[9] Differences between production and consumption statistics are accounted for by gas consumed in field operations, natural impurities and statistical measurement deviations.

Today, there is no single natural gas market, but a series of individual markets with few linkages to one another. Gas markets range from regulated monopolies in transmission and distribution (as in Trinidad and Tobago) to deregulated networks of transmission pipelines with several buyers and sellers of natural gas (as is the case in the United States). The global market can be subdivided into two distinct provinces: the Atlantic Basin (North, Central and South America, the United Kingdom and continental Europe) and the Pacific Basin (Japan, Australia, Indonesia, Brunei, South Korea, Taiwan and Malaysia). While Atlantic Basin countries transport practically all of their natural gas by pipeline, Pacific Rim countries carry out most of their gas trade by LNG, since the geographic distance precludes any significant pipeline trade. However, difficulties inherent in storing and transporting natural gas over long distances still slant consumption patterns in favour of usage at the point of production. In fact, during 1993 internationally traded natural gas (by pipeline and LNG) accounted for only 18.9 per cent of global consumption.

TABLE 3(b)

GLOBAL NATURAL GAS TRADE, 1993

	Billion cubic metres	% of trade
Global gas trade	337.3	100.0
of which: Pipeline trade	254.0	75.3
of which: LNG	83.3	24.7
Pipeline trade	254	100.0
of which: Pacific Basin	1.5	0.6
of which: Atlantic Basin	252.5	99.4
LNG trade	83.3	100.0
of which: Pacific Basin	61.5	73.8
of which: Atlantic Basin	21.8	26.2

Source: BP Statistical Review of World Energy (1994).

Global trading patterns for natural gas are generally skewed toward pipeline trade, except in cases where energy needs and lack of alternatives make trade in LNG a viable economic proposition. This is reflected in the data. In 1993, pipeline trade accounted for 75.3 per cent of global gas trade, with the balance comprising LNG trade. However, practically all pipeline trade occurs in the Atlantic Basin, while 75 per cent of LNG trade takes place in the Pacific. Table 3(b) illustrates the pattern of global trade.

3.2 Natural Gas in Trinidad and Tobago

The production of natural gas in Trinidad and Tobago was largely associated with crude oil before 1968. Gas was mainly used in oil company operations, both as a fuel in refineries and to enhance crude oil production via gas lift. Notable exception to this practice during this period included the use of gas in fertilizer production and electricity generation. From 1959, the Fedchem fertilizer plant utilized associated gas from the oilfields to produce ammonia, urea and ammonium sulphate. The use of natural gas expanded from 1964, with gas being used to generate electricity for the first time. In 1968, Amoco discovered significant non-associated and associated gas reserves off the east coast of Trinidad while exploring for hydrocarbons. These reserves provided the catalyst for the development of Trinidad and Tobago's gas industry from 1975 to the present time.

Before 1975, producing companies sold directly to downstream users, with producers also owning the pipelines used to transport the gas. In 1975, the Government of Trinidad and Tobago established the National Gas Company as the monopsony buyer of natural gas, and the monopoly seller and transporter of natural gas in Trinidad and Tobago. The development of the sector was boosted by the oil shocks of the 1970s, as high petroleum prices stimulated hydrocarbon exploration efforts by various licensees. These efforts resulted in the discovery of further gas reserves off the southeast and north coast of Trinidad. To further facilitate the company's gas collection and distribution activities, the State funded the construction of cross-country and offshore pipelines in the latter half of the 1970s and first half of the 1980s. To date, only some of the east coast gas fields have been exploited, with the north coast gas reserves remaining undeveloped.

In absolute terms, Trinidad and Tobago accounts for a minuscule portion of gas reserves and production, accounting for approximately 0.2 per cent and 0.3 per cent of global reserves and production, respectively. However, on a per capita basis, the country ranks third among the world's leading gas producing and consuming economies behind Qatar and Canada. Trinidad and Tobago's proven natural gas reserves at the beginning of 1995 amounted to 10.09 trillion cubic feet, sufficient to maintain current rates of production (574 mmcf/d in 1994) for the next forty-eight years. The reserve picture with respect to gas at the beginning of 1995 is shown in Table 3 (c).

Table 3 (c)

TRINIDAD AND TOBAGO:

GAS RESERVES AT THE BEGINING OF 1995

	Proven	Probable	Possible
Billion cubic metres	285.80	169.90	76.00
Trillion cubic feet	10.09	6.00	2.68

Source: Ministry of Energy and Energy Industries.

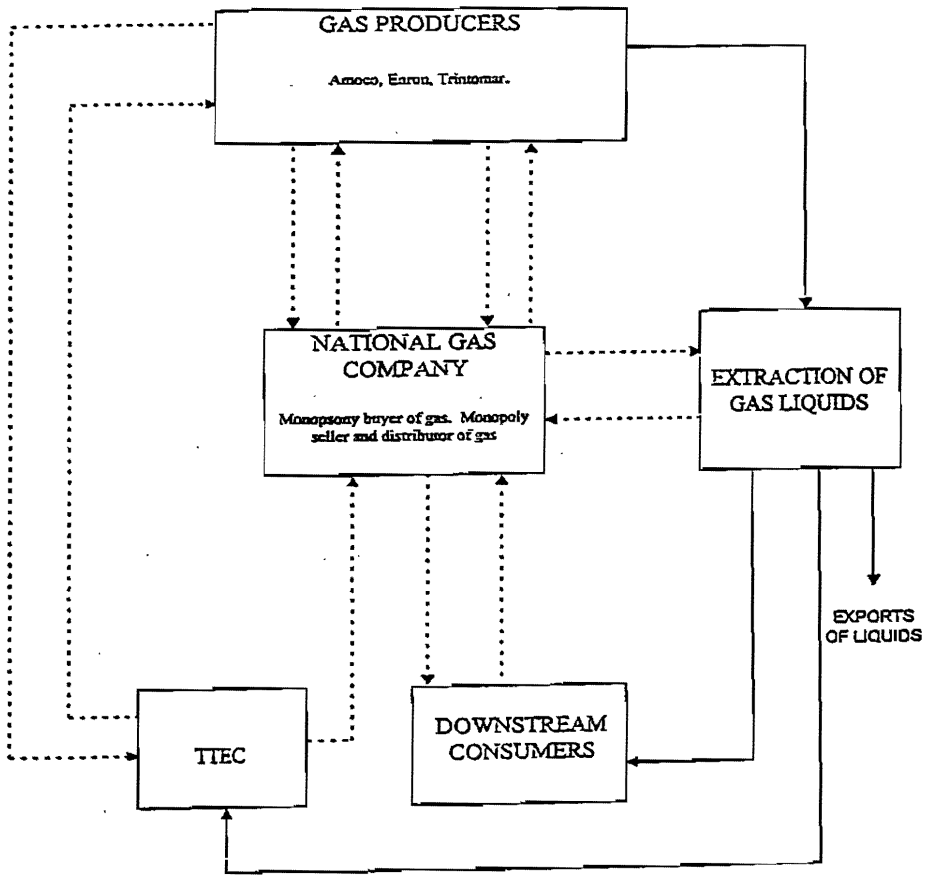
Consistent with other gas-rich countries, the availability of gas supply has propelled the development of gas demand. Between 1975 and 1982 Amoco was the monopoly supplier of natural gas. However, in 1982 the NGC invested in two offshore gas compression platforms in Amoco's Teak and Poui fields to recover low pressure gas that would otherwise be flared. In 1988, the South East Coast Consortium (SECC) through Trintomar commenced efforts to exploit acreage in the Pelican field. Output of gas from that source peaked in early 1991 and declined catastrophically following a blowout on the platform in April 1991. To compensate for the shortfall arising out of the Trintomar incident, Enron Gas and Oil was awarded a sub-license for the SECC acreage (excluding the Pelican field) in 1992 with initial gas delivery in late 1993. Meanwhile, the NGC finalized an accord with British Gas/Texaco to contract gas supplies from the offshore Dolphin field, starting in 1996.

Over time, the structure of the gas market has metamorphosed from a monopoly to monopolistic competition. It is expected that this tendency towards market competition among producers will become even more marked in the future after gas from the British Gas/Texaco licensed acreage comes ashore in 1996. The development of the distribution of supply from 1985 to 1994, with a forecast for 1996, is shown in Table 3(d), while the overall structure of the natural gas market in Trinidad and Tobago is shown in Fig. 3(a).

The market for natural gas in Trinidad and Tobago has been developed over time by deliberate government policy. Over the past twenty years, the State adopted an economic strategy of resource-based industrialization to facilitate economic development. More specifically, the State sought to monetize gas resources and export natural gas indirectly by establishing downstream gas-using export industries. Between 1975 and 1991, development

Figure 3 (a)

ORGANIZATION OF THE TRINIDAD AND TOBAGO GAS INDUSTRY



Source: Central Bank of Trinidad and Tobago.

of the gas sector involved significant capital investment by the State on plant and infrastructure (gas lines, etc.) funded by fiscal surpluses from high oil prices of the late 1970s.

To this end, the government established petrochemical facilities at the Point Lisas Industrial estate including four ammonia plants, one urea facility, an iron and steel minimill, a methanol plant and a natural gas liquids extraction facility. This is reflected in the pattern of natural gas usage over time. Between 1981 and 1994, natural gas utilization rose from 318 mmcf/d in 1985 to 576 mmcf/d in 1994, an annual rate of 9 per cent. In the medium term, it is expected that gas utilization will continue its upward trend, as new gas using industries come on stream. Trends in gas utilization from 1985 to 1994, with a forecast for the year 1996, are shown in Table 3(e).

Table 3(d)

NATURAL GAS SUPPLY SOURCES: 1985 - 1996

mmcf/d / *(%)*

Supplier\Year	1985	1990	1992	1994	1996[f]
Amoco	275.0	303.0	375.0	390.0	350.0
	(78.0)	*(67.9)*	*(73.8)*	*(67.9)*	*(50.9)*
NGC	77.4	92.0	96.0	103.0	100.0
	(22.0)	*(20.6)*	*(18.9)*	*(17.9)*	*(14.5)*
Trintomar	0.0	51.0	37.0	7.0	1.0
	(0.0)	*(11.4)*	*(7.3)*	*(1.2)*	*(0.1)*
Enron	0.0	0.0	0.0	74.0	150.0
	(0.0)	*(0.0)*	*(0.0)*	*(12.9)*	*(21.8)*
British Gas/Texaco	0.0	0.0	0.0	0.0	87.0
	(0.0)	*(0.0)*	*(0.0)*	*(0.0)*	*(12.6)*
TOTAL	352.4	446.0	508.0	574.0	688.0

Source: National Gas Company; Ministry of Energy and Energy Industries.

Table 3(e)

GAS UTILIZATION BY USE IN TRINIDAD AND TOBAGO: 1985 - 1996

mmcf/d / *(%)*

	1985	1990	1992	1994	1996[f]
Power Generation	98	119	137	139	144
	(30.8)	*(26.6)*	*(26.8)*	*(24.1)*	*(21.2)*
Fertilizers	166	219	231	239	251
	(52.2)	*(49.9)*	*(45.1)*	*(41.5)*	*(37.0)*
Methanol	32	36	46	95	112
	(10.1)	*(8.1)*	*(9.0)*	*(16.5)*	*(16.5)*
Other large consumers	14	64	88	92	158
	(4.4)	*(14.3)*	*(17.2)*	*(16.0)*	*(23.3)*
Small consumers	8	9	10	11	15
	(2.5)	*(2.0)*	*(2.0)*	*(1.9)*	*(2.2)*
TOTAL	318	447	512	576	679

Source: National Gas Company; Ministry of Energy and Energy Industries.

An examination of the data shows that petrochemicals and other heavy industry, specifically fertilizers, methanol, and iron and steel have been the catalyst behind the growth in gas usage. Although the relative share of power generation in total gas demand has decreased, absolute usage rose by 5 per cent per year. Similarly, the share of methanol in gas demand increased by 21.8 per cent per annum, primarily due to the startup of the second worldscale methanol plant in 1993. Meanwhile, fertilizers have shown steady growth of 4.9 per cent per annum during the 1985 - 1994 period. Other large consumers (incorporating iron and steel, cement and natural gas liquids) experienced a phenomenal annual growth rate of 61.9 per cent per annum, mainly as a result of increased gas usage at the ISPAT steel plant and the commissioning of the gas liquids extraction facility in 1991.

IV. PRICING AND LEGAL ISSUES

As noted earlier, the quantity and quality of the reserves in Trinidad and Tobago and the new acreage currently being developed indicate that the processing, transportation and utilization of natural gas will surpass petroleum as the dominant economic activity in the country by the turn of the century. Similar to other energy rich territories, the exploration and production of oil has dictated the nature of the fiscal regime with natural gas viewed as a by-product (frequently flared) and pricing and legal issues being largely unstructured. Notwithstanding the government's stated intention to enact a transparent fiscal regime for all aspects of natural gas operations-separate and distinct from the Petroleum Act, the industry in Trinidad and Tobago is characterized by myriad gas contracts ranging from the subsidized price for electricity generation to netback pricing for export industries. Similarly, the existing legal framework in respect of taxation of natural gas provides for significant variations among existing and potential operators.

4.1 Pricing

Internationally, there are two main ways to set gas prices. *Cost-Plus Pricing* entails the buyer paying a price determined by the producer's cost, plus an agreed fee or margin with an adjustment formula, usually based on changes in some pre-determined cost indices. This system has been criticized as unrealistic since it weakens the effect of market forces, encourages inefficiencies and stifles initiative. However, this system is useful in certain situations. For example, in the context of a relatively small and embryonic gas market, this mechanism may be essential. In Trinidad and Tobago, all of the early well head gas pricing contracts negotiated between suppliers and the NGC utilized this formula. Typically, the producer price comprises of an initial price and an annual escalator which allows for predictability and stability in gas acquisition costs. The consumer gas price was also premised on this simple mechanism.

Internationally, the *Market-Value Pricing* system is the most widespread. Under this mechanism, the price paid to the producer is tied to the cost of a substitute (usually fuel oil, naphtha or gas oil). The system is based on the value of gas to final users and incorporates availability, security of supply, convenience as well as the inherent value of the gas. The economic value of natural gas is much higher in industrialized countries due to its many competing uses, including as fuel in power generation, a feedstock for petrochemical production and as liquefied natural gas. By contrast, in developing countries and, to a lesser extent oil exporting regions, natural gas is normally used only in power generation or as a feedstock for petrochemicals. As a result, natural gas prices tend to be lower. This method of well head gas pricing has never been used in Trinidad and Tobago since the relatively low cost of competing fuels would have made investment in gas exploration and recovery uneconomic to producers.

Available prognoses from industry experts in Trinidad and Tobago suggest that over the medium term, well head prices are likely to remain largely stable in real terms on account of surplus deliverability among existing and new suppliers and technological improvements which may extend the life of producing fields. To counteract this possibility and in order to fulfill its mandate to support the development of the gas market in the country, the NGC has adopted a flexible approach to gas pricing. Commencing in 1988, the company moved away

from the fixed price regime and introduced a system of product related network pricing to the major petrochemical companies which utilize gas as a feedstock. The NGC contends that this unique mechanism (as far as international consumer gas pricing is concerned) allows for the sharing of market risks and benefits among parties and that over the medium term prices will move in line with well head prices. This development is consistent with the government's position enunciated in the Draft Energy Policy for Trinidad and Tobago which advocated that the country benefits from the lowest cost gas while guaranteeing security of supply. Selected producer and consumer prices are detailed in Table 4(a) below.

Table 4(a)

TRINIDAD AND TOBAGO: SELECTED GAS PRICING MECHANISMS

Producer / Consumer	Mechanism	Year contracted
Producer / Wellhead Prices		
Amoco	Cost-plus (fixed escalator)	1991
Trintomar	Cost-plus (flexible escalator)	1990
Enron	Cost-plus (flexible escalator)	1993
Consumer Prices		
Arcadian (ammonia)	Flexible (netback)	1992
CMC	Flexible (netback)	1993
Nucor	Fixed (profit sharing arrangement)	1994

Source: Central Bank of Trinidad and Tobago; National Gas Company of Trinidad and Tobago

4.2 Legal Issues

Prior to 1992, Trinidad and Tobago's petroleum tax regime was considered regressive and internationally uncompetitive. In contrast, the gas tax regime has always been among the least onerous globally. In the absence of specific legislation covering natural gas, the legal obligations of producing entities are currently determined by the licensing agreements negotiated on a case by case basis with the NGC acting on behalf of the government. Inevitably, licensing terms vary markedly among companies depending on the relative strengths of negotiating parties. In this regard, the market power wielded by Amoco through its status as the principal supplier of gas enabled the company to maintain its favourable royalty rate in renegotiating licensing terms and contractual obligations in 1991 (See Table 4(b).

Table 4 (b)

TAXATION OF NATURAL GAS

Company	Contracted Volume (mmcf/d)	Year	Tax Rate
Amoco	350	1991	Flat rate royalty: TT $0.015/mmcf
Trintomar	130	1989	12.5 per cent of gas value
Enron	150	1992	15 per cent of gas value

Source: Central Bank of Trinidad and Tobago; Ministry of Energy and Energy Industries.

In response to widespread public concerns over the terms and conditions of negotiated contracts, the government in its Green Paper on Energy proposed the drafting and

implementation of a Natural Gas Act to govern the major issues surrounding natural gas. The elements to be addressed include :

(i) Fiscal regime for the production, sale and utilization of natural gas;

(ii) The treatment of condensate associated with natural gas;

(iii) The instutional framework for the purchase, sale and promotion of natural gas utilization;

(iv) Ownership of the natural gas transmission system and associated fcilities.

In respect of (i) above, the proposed legislation suggests that royalty rates for natural gas wiil be standardized along the lines of models adopted by Thailand, Malaysia and Chile. The anticipated legal framework regarding condensate production indicates that the greatestt possible benefits from this resource will be realized through priority use for local processing and downstream industrial develoment. This notwithstanding, all existing contractual arrangements for processing of condensate will be fully honored.

The remaining issues of the institutional framework for natural gas and ownership of the gas distribution system are directly related. The amended legal framework proffers an expanded role for tthe NGC as the government's prime mover in the future development of the natural gas sector. Toward this end the NGC is now mandated by government as the sole executing agency for evaluating all proposals for natural gas based energy projects. In addition, the company has assumed responsibility for advising goverment on an appropriate incentive regime to attract new investment in downstream industries, promoting Trinidad and Tobago as prime location for gas related investment, and the aggressive marketing of natural gas to small users in the Caribbean for transportation and industrial activity. In the absence of specific legislation, the NGC's role which was formely restricted to its monopsony in gas purchases from producers and its monopoly in gas carriage and sales has been expanded.

V OUTLOOK

In the medium term, the natural gas industry in Trinidad and Tobago is expected to continue to expand. The combination of a shift in the government's energy policy to encourage domestic gas use along with the implementation of ongoing gas sector projects will provide the impetus for rising gas demand well into the next century. Petrochemical industries are forecast to maintain existing growth rates of 8 - 10 per cent per annum, consistent with the commissioning of additional facilities for the production of fertilizer, methanol and the extraction of gas liquids. At present, one ammonia plant and one methanol plant are under construction, with two ammonia, one methanol and one gas liquids plant in the planning stage. In addition, proposals for the establishment of downstream petrochemicals such as ethylene and acetic acid are in the planning stage.

In the area of heavy industry, Trinidad and Tobago is set to become a major centre for iron and steel production in the Caribbean region. Apart from ongoing work at the iron and steel plant, the country is poised to become a major player in the nascent iron carbide industry. Within the last year, Nucor completed construction of the world's first commercial iron carbide facility at Point Lisas. Despite initial technical problems, plans have been advanced for the construction of additional iron carbide modules. In addition, the petroleum

refinery at Pointe-a Pierre which is currently being upgraded will require additional gas volumes from 1996 onwards. Based on a combination of current plans to construct a methyl tertiary butyl ether (MTBE) plant at the refinery, projections point to gas use in heavy industry rising by 14 per cent by 1998.

Lower growth levels are projected in both power generation and light industrial sectors. In the medium term, power generation capacity will remain unchanged. Growth in this sector is expected to shadow overall economic growth and increase by 1 - 2 per cent per annum, based on improved efficiency at existing generating plants. Growth in the light industrial/commercial sector has traditionally been limited by the geographical reach of the gas distribution network. Within recent years, however, gas use in this sector has been promoted via the introduction of compressed natural gas as a alternative vehicle fuel (with 11 stations servicing approximately 2,000 vehicles), the promotion of natural gas cooling in large buildings and the extension of the gas distribution network to serve new areas. Although minuscule in absolute terms, preliminary forecasts point to demand for these uses rising by a minimum of 6 per cent over the next three years.

However, the area of greatest potential gas use is in LNG. For the past two years, Amoco, the NGC, Cabot LNG and British Gas have been discussing the feasibility of establishing an LNG export project in Trinidad and Tobago. To date, all major obstacles to the project (establishment of dedicated gas reserves, markets, financing and the gas sales price) have been removed and the project partners expect to make a formal decision on the undertaking by the end of the year. Assuming a favorable decision, the first shipment of LNG is expected by 1998. Aggregate natural gas usage is expected to rise by 60 per cent upon completion of the project. Notwithstanding the difficulties that have bedeviled most proposed LNG projects over the last few years, it appears that the Trinidad LNG project seems the most likely to succeed, given marketing, financial, lead time and political factors. In fact, compared to a competing proposal for an LNG project in Nigeria, the Trinidad LNG project seems to have an advantage based on the synergy between marketing; financing and political factors. A summary of the LNG project is given in Table 5 (a), while Table 5(b) profiles existing and planned investments in gas-using downstream industries in Trinidad and Tobago.

In sum, over the next three years investments totalling US $2,600 million will impact significantly on the future direction of the natural gas industry in particular and Trinidad and Tobago as a whole. The combined projects are expected to generate a minimum of US $900 million per annum in export revenue by the year 2000. The impact of these projects on the fiscal side is less certain given the predeliction of the State to the granting of tax exemptions and other concessions to investors. However, the magnitude of these projects and the multiplier effects throughout the economy suggest that the contribution to the Exchequer in the long run will be substantial.

Table 5 (a)

TRINIDAD AND TOBAGO LNG: AT A GLANCE

Nameplate Capacity	Single process train, 425 mmcf/d
Project Shareholding (liquefaction facility)	Amoco: 34 per cent British Gas: 31 per cent Cabot LNG: 25 per cent NGC: 10 per cent
Location	Brighton/La Brea
Project Cost	US $1,200 million
Gas Supply	Amoco (100%)
Gas Transmission	Responsibility of project partners
Shipping	Cabot LNG British Gas
Regasification	Cabot LNG Enagas
Contracted Buyers	Cabot LNG (60 per cent) Enagas (40 per cent)
Potential Participants	Enron Gaz de France Texaco
Contracted Gas Price	US $2.00 - $3.00/mmcf fob La Brea (Enagas) US $ 3.50/mmbtu (est. landed price, NE USA) US $ 4.00/mmbtu (est. landed price, Europe)
Markets	NW Europe NE United States
Financier	Citicorp

1 mmcf = 1 thousand cubic feet = 1 mmbtu = 1 million British Thermal units

Table 5(b)

PROFILE OF DOWNSTREAM GAS USERS IN TRINIDAD AND TOBAGO

Company	Start up year	Estimated Cost (US $M)	Product	Daily Gas Usage (mmcf/d)*
OPERATING				
Hydro Agri Trinidad	1959	n.a.	Ammonia	31
Trinidad Nitrogen (Tringen) I	1977	125.0	Ammonia	50
Caribbean Ispat Ltd.	1980	468.3	Direct Reduced Iron Steel Billets Wire rods	38
Arcadian (Ammonia)	1981	333.3	Ammonia	105
Arcadian (urea)	1984	172.5	Granular urea	10
Trinidad and Tobago Methanol Company (TTMC)	1984	182.8	Methanol	47
Tringen II	1988	350.0	Ammonia	46
Phoenix Park Gas Processors Ltd. (NGL I)	1991	98.8	Propane Butane Natural Gasolene	17
Caribbean Methanol Company (CMC)	1993	200	Methanol	49
Nucor	1994	60	Iron carbide	4
SUB - TOTAL	-	*1,990.7*	-	*397*
UNDER CONSTRUCTION				
TTMC II	1996	274	Methanol	60
Arcadian II	1996	75	Ammonia	25
Petrotrin MTBE	1995	13	MTBE	34
SUB - TOTAL	-	*362*	-	*119*
PROPOSED				
Ammonia (Farmland)	1997	300	Ammonia	50
Iron Carbide II	1997	106	Iron Carbide	30
LNG	1998	1,200	LNG	425
TTMC III	1998	250	Methanol	60
Arcadian III	1998	300	Ammonia	50
NGL II	1998	150	Propane Butane Natural Gasolene	15
SUB - TOTAL	-	*2,306*	-	*630*
TOTAL	-	4,658.7		1,146

Source: Ministry of Energy and Energy Industries, Central Bank of Trinidad and Tobago.

SELECT BIBLIOGRAPHY

BOOPSINGH, TREVOR. (1990) *Oil, Gas and Development: A View from the South.* Longman Trinidad Limited, 1990.

JOBITY, RICHARD.(1993) *"The International Nitrogen Fertilizer Industry: A Profile of Ammonia and Urea"*, Central Bank of Trinidad and Tobago, mimeo, 1993.

KEOGH, NESSA. (1995) *"Island In the Sun"*. Nitrogen, March/ April 1995, pp. 17-23.

MC GUIRE, GREGORY AND PANTOR, ROBERT (1989). *"Trade Policy and Export Performance of the Natural Gas Based Industries of Trinidad and Tobago"*. Quarterly Economic Bulletin, Central Bank of Trinidad & Tobago. Vol. XIV, No.2, June 1989

PANTOR, ROBERT (1992) *"Europe 1992 and Recent International Developments: Implications for Trinidad and Tobago's Petrochemical Exports"*. .Quarterly Economic Bulletin, Central Bank of Trinidad and Tobago., Vol.XVII. No. 3, September 1992.

PANTOR, ROBERT. (1993) *"The International Methanol Market"*, Central Bank of Trinidad and Tobago, mimeo, 1993.

TRINIDAD AND TOBAGO (1981). Ministry of Energy and Energy Industries. *"White Paper on Natural Gas"*. 1981.

TRINIDAD AND TOBAGO (1992). Ministry of Energy and Energy Industries. *"A Draft Energy Policy for Trinidad and Tobago - A Green Paper"*. November 1992.

CONFERENCE PROCEEDINGS

CROCCO AND ASSOCIATES. Proceedings of the World Methanol Conference, various years.

INSTITUTE OF GAS TECHNOLOGY. Proceedings of the Conference on *"Natural Gas In The Americas: Strategic Growth and Market Development"* Port of Spain, Trinidad and Tobago. May 9-11, 1994

INTERNATIONAL FERTILIZER INDUSTRY ASSOCIATION. Proceedings of IFA Regional Conference on Latin America and the Caribbean. Port of Spain, Trinidad and Tobago. 8-10 July, 1992.

INTERNATIONAL METHANOL PRODUCERS AND CONSUMERS ASSOCIATION. Proceedings of the First Latin American Methanol Conference, Port of Spain, Trinidad and Tobago. May 11-13, 1992.

UNITED NATIONS. Proceedings of the United Nations Inter-Regional Conference on the Development of Petrochemical Industries in Developing Countries. Teheran, Iran, 16-30 November, 1964.