



**Natural Gas Based Industrialisation in
Trinidad & Tobago: A First Assessment**

by

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INTRODUCTION

Over the last few years, the economy of Trinidad and Tobago has been transformed from an oil-based to a natural gas-based economy. Oil production and refining have been replaced as the main engine of growth and natural gas-based industries are deemed to be the new industries with the potential for growth in the future. The aim of this paper is to examine the nature of the transformation of the economy to a natural gas-based economy, and the strategies and policies that shaped the industry today. The paper looks at the benefits derived from this country's diversification efforts and some of the issues that must be considered by any country pursuing a gas-based development strategy.

Section One considers the technical aspects of natural gas as a commodity and outlines its various uses in industrial and commercial sectors. Section Two examines the world natural gas industry with special emphasis on consumption, production, and reserves gives a brief historical account of the natural gas industry in Trinidad and Tobago and presents some aspects of its industrial organisation. The strategies and policies pursued by the government and the role that these factors played in the development of the local industry are then outlined. Section Four evaluates the benefits that have accrued to the country from the governments' efforts at diversification while Section Five outlines some specific issues critical to the future development of the industry, which include depletion policy, natural gas pricing and an appropriate taxation regime.

* The author is an Economist in the Research Department of the Central Bank of Trinidad & Tobago. Views expressed herein are those of the author and not necessarily those of the Central Bank of Trinidad & Tobago. This paper is an extract from a thesis entitled "The Macroeconomics of Widening Natural Gas Utilisation: Trinidad and Tobago 1974-1997," which has been completed in partial fulfillment of the requirements for a Msc. (Econ).

I. Natural Gas: Some Technical Aspects

Natural gas is a mixture of gaseous hydrocarbons and impurities, the composition of which varies from one gas reservoir to the next. The hydrocarbon constituent ranges from methane to hexanes and other heavy constituents. Natural gas can be used as a fuel, as an energy source for the generation of electricity, or as a feedstock in the petrochemical industry. To understand the utilization of natural gas one must understand the chemistry of alkanes that makes up its basic constituents. The uses for natural gas can be divided into a physical group and a chemical group. In the former, natural gas is used in the generation of heat, steam or electricity. The chemical uses for natural gas involve the process where gas is transformed into chemical products. Appendix Table A1 contains a description of the typical constituents of natural gas.

The heavier components present in natural gas (such as butane, ethane and propane) make excellent feedstock for the production of olefins. The ethane is used to produce ethylene and its co-products, while butane and propane can be sold as liquefied petroleum gas or used in the manufacture of ethylene. Natural gas is used as a feedstock in the production of fertilizers (such as ammonia and urea) for export, or for local use in developing countries with large agricultural sectors. The domestic production of fertilizer therefore offers a large and growing market for natural gas. In addition, because of the high cost of transportation and storage it is economical to produce ammonia and urea domestically, rather than sell natural gas directly. Countries with substantial proven reserves of natural gas will also find it more appropriate to substitute natural gas for diesel or fuel-oil based plants. Since the 1970's Trinidad and Tobago has taken advantage of the upstream aspects of gas development, such that gas is brought from the field and sold largely to the producers of methanol, urea and ammonia, and by 1999 to the Atlantic LNG plant.

Approximately seventy-five per cent of global ammonia production capacity is based on natural gas, the most commonly used feedstock for the production of ammonia. In both the developed and developing world, nitrogen represents about fifty per cent of fertilizer

consumption. While world consumption of nitrogen fertilizers is rising, the use of fertilizers is growing at a much faster rate in the developing countries. Methanol is manufactured through a chemical process based on methane from natural gas. Ninety-five per cent of methanol production is for use in chemical applications, which include uses as a solvent and as a raw material for other chemicals such as acetic acid and single-cell protein. The most common use of methanol is in the production of formaldehyde, which accounts for one-half of methanol consumption. There is a growing market for the use of methanol as an additive to automotive fuel, either by converting to methyl tertiary butyl ether (MTBE), or by blending into conventional motor fuels. Currently, new chemical applications for methanol are being developed which include a process to convert methanol to ethylene, a basic building block in petrochemical production. The result of technological breakthroughs and new processes opens up the possibility of new markets. The possibilities from downstream industries from the methanol, urea and ammonia industries are endless, although Trinidad and Tobago has yet to take full advantage of all aspects of these developments. Table 1 below contains a description of most of the major downstream applications of natural gas.

TABLE 1
MAJOR DOWNSTREAM APPLICATIONS

ETHYLENE DOWNSTREAM APPLICATIONS		PROPANE/POLYENE/POLYPROPYLENE - DOWNSTREAM APPLICATIONS	
Ethyl-Dichloride →	PVC, Solvent	Film →	Snackfood packaging, Overlap for boxes
Poly-Ethylene →	Resin, Film (Sheet)		
Ethyl-Benzene →	Styrene, Resins, SBR, ABS, Rubber		
Ethylene Oxide (EO) →	Detergent, Cement, Adhesive, Cosmetics, Corrosion Inhibitor, Non- Ionic Surface Fumigant	Fibers & Filaments →	Carpet backing, Furniture backing, carpet face yarns, Cordage & Wine
Ethylene Chlorohydrate →	Anti-Freeze, Polyester, Detergents, Solvents, Plasticisers		Automotive interior trim, Air ducts, Signal lamp housing, Bumpers and body parts, Battery cases
Vinyl Acetate →	Plastics, Adhesives →		Caps & closures, Toiletty containers, Prescription vials, Videotape cassette boxes

TABLE 1 (Cont'd)
MAJOR DOWNSTREAM APPLICATIONS

ETHYLENE DOWNSTREAM APPLICATIONS		PROPANE/POLYENE/POLYPROPYLENE - DOWNSTREAM APPLICATIONS	
Ethylchloride →	Anti-Knock →	Injection Molding →	Medical products (syringes, beakers, trays, tubing) Major home appliances (washing machines, clothes dryer, dishwasher)
Ethanol →	Solvent Intermediata		
Butyl Alcohol →	Paint Coatings, Adhesives		
Acetic Acid →	Intermediate to Resins, Rayons		
METHANOL DOWNSTREAM APPLICATIONS		AMMONIA DOWNSTREAM APPLICATIONS	
Chemical Applications →	Formaldehyde: Resins, Adhesive Plastics, Arborite, Plywood	Direct Application →	Ammonium sulphata, Ammonium nitrate - UAN, CAN ammonia gas pumped directly into the soil by special equipment
	Paints, Dyes, Toys. → Nylon, Coatings, Pharmaceuticals, Insecticides, Audio & Video, Cassettes, Stereo & Telephone Components, Thinners, Fiberglass, Acetic Acid	Ammonia in Solution →	Ammoniates (agricultural fertilizers) used in chemical and pharmaceutical industries petroleum industry (to neutralize acids, H ₂ S buffer)
Fuel Applications →	Direct use as Automotive Fuel Blended with Fuel MTBE (Octane Booster) Turbine & Boiler Oil Converted to Gasoline	Nitric Acid →	Explosives, resins, dyes
		Soda Ash Manufacture	Manufacture of soda ash (industrial chemical)
Other Applications →	Single Cell Protein, Reducing Agent (Steel Mill), Fuel Cells, Batteries, Olefins, Sewage Sludge Treatment	Textile Manufacture	
		Urea →	Resins, Melamina Kitchenware, Fertilizers
		Miscellaneous →	Synthetic ice, synthesis of medicinal drugs, plastics, fuels, manufacture of paint removers polishers and cleaning agents ammoniated dental products

II. The World Natural Gas Industry: Production, Consumption and Trade

World consumption of natural gas has been increasing in recent years. Previously, trends in global gas consumption were limited to domestic gas markets because of the difficulty of transporting natural gas. Advances in technology however, have made it easier to transport gas to wider and more geographically dispersed locations. Today, natural gas is transported by pipelines as well as by ships. As a result, areas that were previously without economically accessible supplies can now import and use liquified natural gas LNG as an alternative energy form. In addition, because of its qualities as a feedstock and as a 'clean' fuel, natural gas has become an alternative to oil, coal, hydroelectricity and nuclear fuel in major energy consuming sectors.

Outside of the Former Soviet Union (FSU), global gas consumption has increased over the last two decades with consumption growing by 23 per cent between 1984 and 1996. Geographically the largest consumer of gas is the North American continent, representing 34 per cent of the world's total consumption. Most of the gas trade carried out between and within the USA and Canada takes place by pipeline given the large domestic market. The FSU is the second largest consumer representing (24 per cent), Western Europe (19.1 per cent), Asia and Australasia (10.7 per cent), the Middle East (6.5 per cent), Latin America (4.3 per cent), and Africa (2.2 per cent). In tandem with the increase in consumption there has also been growth in gas production. This increase in outturn is often attributed to the impact of the oil shocks of the 1970s, which prompted renewed interest in alternatives to oil which would decrease the world's dependence on the Middle East. Advances in transportation technology also impacted on the level of production as it is now possible to have easier access to several different markets. The major reasons cited for the rise in world gas production are rising economic growth and substitution for coal and fuel oil by natural gas as well as advances in drilling technology, (e.g. horizontal drilling) which made new and additional gas reserves easily accessible. New uses for natural gas are constantly being discovered and so countries have increased their gas production either to develop new local and export industries or to

exploit these new uses. The world's largest natural gas producer is the FSU which accounts for 33.2 per cent of global gas output. The second largest producer is North America, representing (31.1 per cent), followed by Western European (10.9 per cent), Asia and Australasia (9.6 per cent), the Middle East (7 per cent), Africa (3.8 per cent) and South and Central America (4.6 per cent). Tables 2 and 3 contain selected data for selected years on natural gas consumption and production, respectively.

TABLE 2
WORLD NATURAL GAS CONSUMPTION: Selected Years 1984-1996
(BCM)*

YEAR	1984	1988	1990	1992	1994	1995	1996	% of world
North America	602	605	629	658	690	721	737	34.0
South & Central America	45	54	59	62	68	78	94	4.3
Europe	289	312	325	333	352	378	418	19.1
Former Soviet Union	497	621	553	628	548	522.4	526	24.0
Middle East	56	90	95	106	126	132	142	6.5
Africa	22	30	33	37	41	45	48	2.2
Asia And Australasia	101	133	159	179	205	218	235	10.7
TOTAL	1,612	1,845	1,964	2,003	2,030	2,094	2,191	100

SOURCE: BP Statistical Review of World Energy, 1997

TABLE 3
WORLD NATURAL GAS PRODUCTION: Selected Years 1984-1996
(BCM)*

YEAR	1984	1988	1990	1992	1994	1995	1996	% of world
North America	605	610	640	658	706	711	731	32.7
South & Central America	45	55	53	62	68	76	84	3.7
Europe	223	216	215	225	239	246	279	12.5
Former Soviet Union	548	718	760	728	671	670	669	29.3
Middle East	59	93	93	110	130	139	180	8.0
Africa	43	59	67	75	76	85	91	4.0
Asia And Australasia	98	133	150	176	201	211	227	10.2
TOTAL	1,623	1885	1988	2034	2090	2127	2231	100

SOURCE: BP Statistical Review Of World Energy, 1997

* one cubic metre = 35.31 cubic feet
* one cubic feet = .02832 cubic metre

Proven reserves of natural gas have been increasing over the past few years. More importantly, gas reserves (unlike oil) are distributed in relatively substantial quantities and geographically diverse locations, which means that there is a greater potential for more security and stability of supply. The FSU and the Middle East have the largest quantum of reserves, with the FSU accounting for 40.5 per cent of the total, while the Middle East has 32.5 per cent. Of the remainder, Asia and Australasia account for 6.5 per cent, North America 6 per cent, Europe 4.2 per cent, Africa 6.6 per cent, with Latin America accounting for 4.2 per cent of global reserves. (See Table 4).

TABLE 4
WORLD NATURAL GAS RESERVES - Selected Years 1984 - 1996
(BCM)

YEAR	1984	1988	1990	1992	1994	1995	1996	% of world reserves
North America	10,401	10,113	9,530	9,449	8,816	8,470	8,530	6.0
South & Central America	3,056	4,568	4,801	5,340	5,355	5,760	5,890	4.2
Europe	5,852	5,666	6,501	6,025	6,125	5,480	5,420	3.8
Former Soviet Union	41,059	42,475	45,307	54,999	55,592	55,230	57,230	40.5
Middle East	24,517	33,474	37,499	43,045	45,144	45,230	45,750	32.5
Africa	5,300	7,173	8,211	9,822	9,673	9,470	9,310	6.6
Asia And Australasia	5,581	7,712	8,554	9,656	9,929	9,300	9,110	6.5
Others	467	821	-	-	-	-	-	-
TOTAL	96,334	112,002	119,401	138,337	141,024	139,710	141,230	100

SOURCE: BP Statistical Review of World Energy 1997

* one cubic metre = 35.31 cubic feet
* one cubic feet = .02832 cubic metre

Within the last decade, international trade in natural gas developed as gas production and consumption increased. Gas trade by pipeline and LNG exports accounted for 21.6 per cent of world output. The most critical area of growth in gas trade has been in LNG shipments as world LNG trade totaled 102.4 bcm in 1996, an increase of 5 per cent over the preceding year. LNG demand in Japan rose from 57.9 bcm in 1995 to 63.6 bcm in 1996, an increase of 9 per cent, while total demand for LNG in Asia & Australasia (including Japan) grew by 11.2 per cent. The FSU is the world's major exporter of natural gas, followed by Canada and the United States. In 1996, the largest importers of natural gas (through pipeline) were the North

TABLE 5
LNG IMPORTERS: 1984-1996
(BCM LNG)

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
U.S.A	1.0	7	1	-	.6	1.2	2.5	1.9	1.2	2.3	1.5	0.6	1.2
Belgium	1.6	2.4	2.5	2.9	2.9	3.7	4.0	4.0	4.6	4.3	4.0	4.1	4.0
France	8.1	7.9	7.7	9.4	8.9	9.0	9.3	9.3	9.2	9.0	7.6	8.5	7.5
Italy	.3	.3	-	.2	.3	.3	.03	0.1	.6	.9	.1	.1	-
Spain	2.0	2.4	2.4	2.5	3.2	3.7	4.4	5.5	5.8	6.0	6.0	7.1	6.9
Turkey	-	-	-	-	-	-	-	-	-	-	-	1.4	2.3
U.K.	-	-	-	-	0.1	0.1	0.5	-	-	-	-	-	-
Germany	-	-	0.12	-	-	-	-	-	-	-	-	-	-
Japan	34.7	37.2	39.3	39.3	41.9	43.6	47.9	50.6	52.5	53.0	56.8	57.9	63.8
S. Korea	-	-	0.15	1.9	2.6	2.6	3.08	3.6	4.6	6.0	7.0	9.4	13.0
Taiwan	-	-	-	-	-	-	.9	1.9	2.2	2.3	3.0	3.5	3.4
TOTAL	48.0	50.9	51.2	56.1	60.5	64.5	72.1	76.9	80.9	83.2	87.8	92.6	102.4

SOURCE: BP Statistical Review of World Energy, 1997

TABLE 6
LNG EXPORTERS (BCM-LNG)*
1984-1996

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
U.S.A	1.4	1.4	1.3	1.3	1.3	1.3	1.4	1.3	1.4	1.4	1.5	1.6	1.8
U.A.E	2.8	3.1	2.9	2.9	2.8	3.1	3.2	3.5	3.4	3.4	4.3	6.8	7.4
Algeria	12.1	12.7	12.0	14.0	14.9	17.0	19.0	19.1	19.5	20.1	18.1	18.3	19.6
Libya	1.1	1.0	.8	.8	1.1	1.4	1.2	1.6	1.6	1.6	1.5	1.5	1.2
Australia	-	-	-	-	-	.9	3.6	5.2	6.2	6.7	8.5	9.8	10.1
Brunei	7.4	6.9	7.0	7.0	7.3	7.1	7.2	7.0	7.1	7.5	7.7	8.4	8.7
Indonesia	18.9	19.0	20.3	22.1	25.6	24.9	27.6	29.7	31.6	32.0	35.1	33.1	35.9
Malaysia	4.7	6.0	6.9	8.0	8.3	8.7	8.6	9.6	9.8	10.5	10.5	12.9	17.7
TOTAL	48.0	50.1	51.2	56.1	60.5	64.5	72.1	77.0	80.9	83.2	87.8	92.6	102.4

SOURCE: BP Review Of World Energy Gas, 1997

*one cubic metre = 35.31 feet

*one cubic feet = .02832 metre

American and Western European countries. Nevertheless of total trade in natural gas Japan accounts for 63.8 per cent, South Korea 13.0 per cent and France 7.5 per cent.

All the recent trends point to continued growth in natural gas reserves, consumption, production and international trade. Large reserves suggest relative energy security, while the variety of producers imply supply heterogeneity. Natural gas is a more cost-effective and environmentally friendly fuel than other clean energy resources such as hydroelectric power, solar and geothermal energy. Hydroelectric power generation has many drawbacks as this energy source displaces people from their lands, alters ecological systems, and imposes significant environmental costs. Moreover, capital requirement for solar and geothermal energy per unit of energy output is too high to supply energy needs. Natural gas therefore has a competitive advantage in meeting energy requirements and displacing environmentally unfriendly hydrocarbon fuels, such as coal and to a lesser extent oil.

Gas continues to show underlying strength in all key markets. The economic efficiencies of gas in power generation and its environmental friendliness have contributed to making gas the fastest growing fossil fuel in the world. Trade in LNG continues to strengthen and pipeline networks continue to expand, improving the relative cost competitiveness of gas over other fossil fuels.

III. The Natural Gas Industry In Trinidad And Tobago: History, Strategies And Policies

Historical Development Of The Natural Gas Industry In Trinidad And Tobago

Before 1970, most of the natural gas produced in Trinidad and Tobago was a by product of crude oil production and was flared. By the 1970s, efforts were made by the Government of Trinidad and Tobago (GOTT) to monetize the gas resources of the country. The result was the construction of the Point Lisas Industrial Estate, where natural gas was to be used as a base for industrial development and the eventual transformation of the economy. With declining oil production and revenues, natural gas was seen as the prime alternative future

source of income and foreign exchange. Nonetheless while economic policies for the crude oil sector were well thought out, planned policymaking for the natural gas sector was ad-hoc and largely accidental. Few policies at the time dealt with issues surrounding the development of a sound natural gas strategy, as this non-renewable resource was viewed not as a separate energy source and revenue earner, but as a by-product of crude oil production. As a result, the laws and regulations that applied to the oil sector were also applied to natural gas.

In the early years of the development of the industry, natural gas was not a readily saleable product. At that time the major use for gas was as a fuel source in the oil fields and the oil refineries. After 1954 however, there was a marked increase in natural gas production. Gas production increased from 110 mmcsf/d in 1955 to 414 mmcsf/d in 1968. This increase in gas production was due to the discovery of two new crude oil fields: the offshore Soldado field in 1954, and the Navette field in Guayaguayare in 1965.

There was also a corresponding increase in the consumption of natural gas. In 1955, the Trinidad and Tobago Electricity Commission (T&TEC) and Trinidad Cement Limited (TCL) began to use gas as a fuel. In 1959, the US multinational W.R. Grace commissioned a subsidiary plant at Savonetta (Federation Chemicals Limited, or FEDCHEM) to use natural gas as a feedstock in the production of anhydrous ammonia. Usage by FEDCHEM was less than one mmcsf/d (0.7) in 1959, rising subsequently to 2.91 mmcsf/d by 1968.

In its *Third Five-Year Plan: 1969-1973*, the GOTT noted the contribution that gas could play in the economy. The GOTT while recognizing that direct gas revenues may not have compared with that of the oil sector, emphasized that natural gas could serve as the basis for a huge petrochemical complex, if gas were to be found in commercial quantities. It was noted that the success of any gas development strategy relied critically on reliable and adequate supplies of gas. Drilling off the East Coast was done mainly by joint ventures, thus the rate of discovery of additional reserves determined the rate of industrial activity.

During the late sixties and early seventies there were no major changes in the natural

gas industry. Petroleum policy at the time made mention of natural gas as a "spin-off industry" (*Government of Trinidad and Tobago, 1972 Budget Speech*) and the major prospects for the period were a proposed liquefied natural gas (LNG) plant, and a liquid ammonia plant (*1973 Budget Speech*). With the proposed Point Lisas Industrial Estate, natural gas in Trinidad and Tobago was identified for upstream use in the petrochemical sector, as a fuel in power generation, in the steel and metals industry, for use in secondary oil recovery, and for export as LNG.¹

Subsequent government reports in the eighties cited many areas for investigation. These included the sale and supply of natural gas, licenses and production sharing contracts, multinational participation, new acreage for development and the project to export natural gas directly as LNG. In the *White Paper on Natural Gas (1981)* and the *Draft Energy Policy (1987)* provisions were made which guaranteed a low gas price to T&TEC and an electricity tariff policy was designed to discourage wastage.² In addition, the government reported that efforts would be made to improve the production and distribution of gas.³

The Draft Energy Policy (1992) also pointed to the increased importance that natural gas would play in the future economic development of this country. As in 1987, government delineated the fiscal regime for the production, sale and utilization of natural gas, the treatment of condensate associated with natural gas, a pricing regime for natural gas, an institutional framework for the purchase, sale and promotion of natural gas, and a research and development policy. Today, one of the main objectives of policy is to sell more gas, which is evidenced by the many new leases and contracts signed by foreign companies for exploration into deep water acreage in the North and South East Coast.

Natural Gas Strategy In Trinidad And Tobago

The GOTT concluded that natural gas was the only other significant resource available in commercial quantities that would arrest the decline in revenue resulting from the decline in oil prices. The strategy proposed centered around the increased usage of natural gas. As a result, the issues of capital, technology acquisition and policy decisions had to be addressed if production and utilization of gas were to increase.⁴

With the many uses proposed for natural gas, the GOTT continued to award new leases and increase the number of seismic surveys and contracts to foreign entities. Before 1974, the supply and transport of natural gas were carried out by the producing companies. After 1974, the GOTT delegated this responsibility to the newly formed National Gas Company (NGC), which acted as the sole intermediary between producer and consumer. The NGC was also given exclusive rights to operate, build and acquire pipelines outside licensed areas through negotiations with gas producers. The method of natural gas pricing was also changed when NGC took over the purchase, transport and sale of gas. Before gas was purchased at a price that would "yield a reasonable return on investment" to the producers. Now, following the publication of the *White Paper*, the GOTT mandated that prices should reflect the economic and operating environment in which producers conducted their business, while the prices to consumers would be subject to various principles, depending on need and gas utilization.

In the 1981 White Paper, the GOTT issued guidelines in respect of gas pricing. Gas pricing for electricity was to be determined by principles based on social equity, so to encourage usage by small consumers and to serve as a catalyst for industrialization. Natural gas was to be priced at a level that provided a competitive advantage to this fuel, as opposed to oil, and provide maximum national benefits when exported either as LNG, or indirectly as ammonia, methanol or urea.

Energy policies in the 1990s were enunciated in *Energy Policy for Trinidad and Tobago: A Green Paper*.⁵ This paper re-emphasized the importance of gas to foreign

exchange, income and employment opportunities, and the need for economic diversification based on natural gas-based industrialization. The GOTT also recognized the need for continuous foreign investment, technology, partnership, markets, and research and development. The State proposed the creation of an environment conducive to foreign investment by employing appropriate fiscal régimes and a gas pricing policy. In addition, the GOTT provided tax incentives to encourage exploration and development of new gas fields to service new investments in the gas sector. To facilitate additional foreign interest in the gas sector, a Natural Gas Act (NGA) will be introduced to establish a transparent fiscal regime for all aspects of gas operations.⁶ The Act is supposed to treat gas exploration, production and transmission separately from the Petroleum Act and to refrain from a standardized royalty on natural gas.

While the current pricing policy remains variable dependent on the consumer, the pricing indicator for the sale of gas is supposed to be made public. In addition, where gas is used to produce goods for export markets, provision would be made for responses to price movements in the international market. The price régime will treat the power generation company, ammonia and urea producers, and new users on a cost-related basis. Under the NGA, flaring will be minimized and the development of the sector will be structured to ensure the production of gas at the lowest cost. The GOTT also proposed a long term plan for gas to serve as a planning tool for existing producers and to guarantee supply security for any existing or potential long term use of gas.

Under the new policy, the NGC will be the prime mover in the future development of the natural gas sector. In addition, the role of the NGC as sole buyer and seller of all gas produced within this country, as owner or producer, or as a main transmission company, shall be clearly defined. The NGC will also evaluate proposals for gas-based projects, especially where the GOTT has participatory interests. It will monitor and guide the projects of the State in the implementation stage as well as advise the GOTT on an appropriate regime of incentives to stimulate the development of downstream industries in the petrochemical sector. Currently, the GOTT is in the process of developing new gas-based industrial complexes as proposed in

the 1992 Draft Energy Policy. The Policy also pinpointed divestment as a future influence on the sector, and by 1997 this had already taken place in the majority of the gas-based industries at Point Lisas.⁷

The Industrial Organization of The Local Gas Industry

In 1968, the discovery of significant gas reserves by AMOCO Trinidad Oil Company (ATOC) in its licensed area off the east coast of Trinidad, provided a catalyst for the rapid expansion of the industry in the 1970s.⁸ The increased discoveries of gas reserves resulted from the intensification of oil exploration efforts in the 1970s following the two oil shocks. Most of these reserves (approximately 67 per cent) are located in the East Coast Marine Area (ECMA) are pure gas fields which are unassociated with oil. The remaining reserves are located in the North Coast Marine Area (NCMA) which is currently being developed. The present proven reserves-to-production ratio is now estimated at 49.5 years, but the Ministry of Energy estimates that the ratio increases to 75 years if possible and probable gas reserves are included (1998).

Production/Supply

Table 7A gives an indication of the volume of natural gas (in bcm and tcf) produced (and consumed) in Trinidad and Tobago between 1984-1997. Most of the gas supplies comes from four companies, with ATOC accounting for 329.4 mmcf/d in 1997, representing 43.9 per cent of total output. British Gas supplies 154.9mmcf/d, (21.4 per cent), Enron supplies 133.58mmcf/d or (18.5 per cent), and the National Gas Company has 98.9mmcf/d (13.6 per cent) of total supply. Other small suppliers are Trintomar (3 mmcf/d), Mora Venture and Coastline International who account for less than 1 mmcf/d.

Utilization/Consumption

The major gas consumers at Point Lisas are the petrochemical plants, which include PCS Nitrogen (4 plants - which produces ammonia and urea), Hydro-Agri (2 plants - ammonia), the Trinidad and Tobago Methanol Company (TTMC 1&11, 1V, methanol) and the Caribbean Methanol Company (CMC, methanol). This grouping accounted for 56.9 per cent

TABLE 7A
NATURAL GAS RESERVES, PRODUCTION AND CONSUMPTION (BCM)*
Trinidad and Tobago: 1984-1989

	1985	1986	1987	1988	1989	1990
RESERVES (Trillion cubic feet)	297.3 (10.5)	294.5 (10.4)	294.2 (10.4)	297.3 (10.5)	282.3 (10.0)	282.3 (10.0)
PRODUCTION (Trillion cubic feet)	4.1 (.14)	4.3 (.15)	4.5 (.16)	5.0 (.18)	5.1 (.18)	5.1 (.18)
CONSUMPTION (Trillion cubic feet)	4.1 (.14)	4.3 (.15)	4.5 (.16)	5.0 (.18)	5.1 (.18)	5.1 (.18)
	1991	1992	1993	1994	1995	1995
RESERVES (Trillion cubic feet)	252.0 (8.91)	246.4 (8.7)	237.7 (8.4)	239.5 (8.5)	300.0 (10.59)	350.0 (12.35)
PRODUCTION (Trillion cubic feet)	5.7 (.20)	6.0 (.21)	5.9 (.21)	6.2 (.22)	6.1 (.22)	7.1 (.25)
CONSUMPTION (Trillion cubic feet)	5.7 (.20)	6.0 (.21)	5.9 (.21)	6.2 (.22)	6.1 (.22)	7.1 (.25)

SOURCE: Ministry of Energy and BP Review of World Energy, 1997.

* one cubic metre = 35.31 cubic feet
*one cubic feet = .02832 cubic metre

TABLE 7B
NATURAL GAS RESERVES - BCM (TT)
1998-01-01

TRILLION CUBIC FEET		RESERVE LIFE YEARS
TOTAL RESERVES	25.34	74.3
of which proven reserves	17.27	49.5
of which probable reserves	5.17	16.0
of which possible reserves	1.47	8.2

SOURCE: Central Bank Of Trinidad And Tobago

of gas use at Point Lisas. The second largest consumer is Powergen (power generation) with 27.5 per cent, while Nucor (iron carbide), Phoenix Park (propane, butane and natural gasoline recovery) and small consumers make up the remaining 10.2 per cent. The gas is mainly used as a feedstock in the manufacture of chemicals and fertilizers, while with the other main use of the gas is power generation. (Table 8)

TABLE 8
PRODUCTION AND UTILIZATION OF CRUDE OIL AND
RELATED PRODUCTS AND PETROCHEMICALS: 1993-1997

COMMODITY GROUP	1993	1994	1995	1996	1997
Natural Gas (Mn cubic feet/day)					
Production	684.7	744.0	773.6	689.6	723.0
Utilization	506.0	575.0	592.0	692.0	714.0
of which: Petrochemicals	287.0	334.0	335.0	417.0	427.0
T & TEC	136.0	139.0	149.0	154.8	167.0

Table 8 also indicates that there has been overall growth in gas utilization over the period 1984-1996. In 1984, gas consumption totaled 4.1 bcm (0.4 tcf), but by 1996 this had increased to 7.1 bcm (0.25 tcf). A main determinant of this growth has been the commissioning of new gas-based plants, such as CMC in 1993, Nucor (1994), TTMC 11 (1996), and Nitrogen (1997). Future consumption will increase as Farmland Mississippi Chemicals (April 1998), PCS Nitrogen Trinidad (1998), Methanol IV (June 1998), Titan Corporation (1999), Cleveland Cliffs DRI (October 1998) and Atlantic LNG (1999) come on stream. By the end of 1999, it is expected that demand for natural gas will be around 1,541 mmcf/d.

Table 9 reveals the projected gas demand over the next few years. The base scenario takes into account plants that are definitely coming on stream over the next three years, while the high demand includes those projects that will definitely come on stream and those that may be commissioned. The demand by Atlantic LNG is listed separately.

TABLE 9
NATURAL GAS DEMAND
(mmcf/d)

CATEGORY	ACTUAL 1997	FORECAST 1998	FORECAST 1999	FORECAST 2000
Demand (base scenario)	723.0	880.0	1,047.0	1,112.0
Demand (high demand scenario)	723.0	880.0	1,089.0	1,177.0
Demand (Atlantic LNG) Train one	n.a	n.a	200.0	450.0
TOTAL				1562

SOURCE: The author's projections are based on existing and new project gas demand.

Table 10 shows petrochemical output in Trinidad and Tobago between 1984-1995.

The data indicate that the production of ammonia, methanol and urea rose significantly during the period. In 1984, total production of ammonia amounted to 3,580 tonnes per day, but by 1997, this had increased to 5,740 tonnes per day, as PCS and Hydro-Agri built three new plants during the period. Similarly, the production of methanol rose from 657 tonnes per day in 1984 to 4,115 tonnes per day in 1997 due to the addition of two new methanol plants.

TABLE 10
TRINIDAD AND TOBAGO: PRODUCTION OF PETROCHEMICALS,
1984 - 1997
(tonnes per day)

YEAR	TOTAL AMMONIA	TOTAL METHANOL	TOTAL UREA
1984	3,580	657	445
1985	3,622	987	934
1986	3,833	908	1,343
1987	3,674	1,169	1,297
1988	4,911	1,148	1,473
1989	5,063	1,118	1,332
1990	3,779	813	1,024
1991	5,315	1,238	1,440
1992	5,121	1,315	1,311
1993	4,717	1,373	1,445
1994	5,452	2,782	1,364
1995	5,525	2,782	1,568
1996	5,779	3,722	1,544
1997	5,743	4,115	1,629

SOURCE: Ministry of Energy, 1998.

IV. The Benefits Derived From The Gas Based Efforts

McGuire (1981) argues that between 1973 and 1979 the TT economy had done reasonably well in generating foreign exchange from the hike in oil prices. This success allowed the State to use a portion of the oil revenues to invest in natural gas-based industries. The objective of these investments was to diversify the economy from its reliance on oil

revenue and to create an alternative form of revenue subsequent to the fall in oil prices and petroleum production (*White Paper on Natural Gas, 1981*). As a result, the economic strategy implemented between 1974 and 1982 was natural gas-based export-oriented industrialization. The cornerstone of this policy was direct state participation in natural gas-based industries.

Table 11 describes the investments, product, capacity and start-up date of the energy based plants that were built with GOTT equity in the mid-1970s and 1980s, as well as details the current ownership structure of the industry. Between 1977 and 1984 investment in the sector, amounted to approximately US\$1,569.1 million. By 1997, this had increased to US\$2,183 million and if Phoenix Park Gas Processors Limited (US\$98.8 million), and the Atlantic LNG Plant (US\$936 million are included this amounts to US\$3,217.8 million. Prior to 1992 investment in the sector was dominated by the GOTT, but after 1992, most of these plants were divested to foreign entities. Since then new investments in the sector have largely been by foreign-owned companies. With this pattern of ownership, (where foreign investors hold the majority interest in the gas-based sector), one would expect that the government's share in the benefits would be from the sale of gas to the companies, taxes on these companies and gas royalties.

Project design and construction of petrochemical plants at Point Lisas are carried out by foreign companies and then turned over to local concerns as turnkey operations. The technology required for the oil and gas sector has always been imported or licensed from external sources. What usually occurs is that a foreign company (eg. M.W. Kellogg) is commissioned to build the plant and after engineering and construction, the plant is handed over as a turnkey operation. The plants at Point Lisas are involved in the production of primary commodities geared for exports, where more than 95 per cent of production is exported and only a small percentage of output is used locally. The industry continues to be a major importer of foreign technology and capital goods, however local contractors are employed extensively in the initial construction of the facilities.

TABLE 11
CURRENT INVESTMENT AND OWNERSHIP STRUCTURE
IN GAS-BASED PROJECTS IN TRINIDAD
(US \$Mn)

COMPANY	START UP YEAR	ESTIMATED COST (US \$M)	PRODUCT	CAPACITY '000 tonnes/annum	INITIAL OWNERSHIP (GOTT)	CURRENT OWNERSHIP
Tringen 1	1977	125	Ammonia	500	GOTT (51%) Hydro- Agri (49%)	GOTT (51%) Hydro- Agri (49%)
Tringen 11	1988	350	Ammonia	454	GOTT (51%) Hydro- Agri (49%)	GOTT (51%) Hydro- Agri (49%)
ISPAT	1980	426.3	Iron & Steel	1.3 & 1.2 MPTY	100%	ISPAT (100%)
PCS 1	1981	--	Ammonia	454		PCS 100%
PCS 11	1981	--	Ammonia	454		PCS 100%
PCS 111	1996	75	Ammonia	250		PCS 100%
PCS 1V	Mar. 1998	252	Ammonia	600		PCS 100%
Farmland/ Mississippi	Apr. 1998	300	Ammonia	600		Farm (50%)/Missi (49%)
TOTAL AMMONIA				3 539		
PCS	1983	--	Urea	580	100%	PCS (100%)
TOTAL UREA				580		
TTMC 1	1984	120	Methanol	500	100%	-CL Fin. - (11.25%) -Ferrostaal (62.5%) -Helm (26.25%)
TTMC 11	1996	235	Methanol	550		-CL Fin. - (11.25%) -Ferrostaal (62.5%) -Helm (26.25%)
CMC	1993	200	Methanol	500		-CL Fin. - (64.9%) -Ferrostaal (25.1%) -Methanex (25.25%)
CMC 11 (Methanol 1V)	Apr. 1998	265	Methanol	550		-CL Fin. - (70%) -Ferrostaal (30%)
Titan Methanol Co.	1999	261	Methanol	860		-Amoco (15%) -Saturn (10%) -Bazcon and Kingwood (75%)
TOTAL METHANOL			Methanol	2,980		

SOURCE: Ministry of Energy

The downstream aspects of gas-based development are yet to be fully explored Trinidad and Tobago as there is little or no industrial development in the production of higher-valued products such as plastics, rubber and nylon. Some of the factors which have impacted negatively on these developments are:-

1. High costs of building downstream plants;
2. The limited supply of raw materials; and
3. Difficulty in accessing markets.

Some commentators have argued that the GOTT should provide appropriate incentives for downstream industries because numerous incentives have been already provided for primary producers of urea, ammonia and methanol. Trinidad and Tobago can now be considered to have in place a mature natural gas industry. Provision of incentives for downstream industries implies that in the future the country can become a producer of higher valued products not subject to the vagaries of price fluctuations experienced primary producers. The numerous downstream applications have implications for increased employment and revenue.

Maximization of Government Revenue

Natural gas was perceived by energy planners as the fuel of the future, the new lead sector, and a panacea for the decline in the oil revenues. As such, if gas were to be the catalyst for change and development, then policy should seek to achieve a number of specific objectives, the most important being the maximization of revenue from the industry in the long run. The factors determining levels of revenues are royalty payments and the government's profit share in cases where it has equity participation. As already indicated there is no specific separate tax regime for natural gas but the government collects royalties from natural gas producers and the amount varies between producers depending on their individual contracts. If the country intends to maximize the revenues from natural gas there must be appropriate pricing and taxation policy.

Employment

The gas-based industries located at Point Lisas are all highly capital intensive, which

means that the levels of employment generated in this sector will always be minimal. During the construction phase of a typical plant (two to three years), the maximum level of employment is around 3,000 persons. After construction, permanent employment in each plant is normally between 75 and 100 persons. Over the past few years despite the fact that several more plants had been constructed at Point Lisas employment levels have not risen very sharply. This has occurred as most plants are now constructed in a shorter period of time (18 months) because of the new technology and expertise employed. Permanent employment is also falling as plants are becoming more automated, companies will expand but will not employ additional staff.⁹ Table A4 reveals that average employment in the oil sector (including oil exploration, production and refining) has been declining since 1981, while employment in the gas-based sector has been rising, albeit only marginally. In 1978, employment in the oil sector was approximately three per cent of total employment, while in the gas-based sector employment was less than one per cent of total employment (0.2 per cent). By 1990, employment in the oil sector had fallen to 1.6 per cent of total number of persons and in the gas-based sector employment had increased to 0.5 per cent.

National Income

Table 12 details data on real GDP as well as value added in the oil and the natural gas-based sectors between 1977 and 1995. Real GDP grew between 1979 - 1982, but fell sharply during the 1980's. This fall off occurred against a background of a fall in crude oil prices. However while real value added for the oil sector declined between 1977 and 1995, while real in the gas sector this grown has during the same period. Since 1995 real value added in the gas based sectors has grown despite an uneven performance in the oil based economy.

Net Foreign Exchange Earnings and Financial Performance - Profit and Loss After Tax

Table 13 examines the net foreign exchange earnings of the gas-based sector during the period 1985-1997. In 1985, the plants was built with GOTT equity experienced losses of US\$79.7 million, but by 1986 the losses had escalated to US\$114 million. However by the time that the plants had begun to turn around most of them had been divested.

TABLE 12
NATIONAL INCOME
VALUE ADDED (1985 CONSTANT PRICES)
(TTS Mn)

YEAR	WHOLE ECONOMY	OIL SECTOR	ISCOTT AND PETROCHEM.	GROWTH RATE (OIL)	GROWTH RATE (GAS)
1977	15,732.2	6,139.0	49.7	--	--
1978	17,490.8	6,213.9	91.8	1.22	84.71
1979	18,446.6	5,876.9	87.9	-5.42	-4.25
1980	20,672.1	5,793.3	99.8	-1.41	13.54
1981	21,479.6	5,056.2	67.0	-12.73	-32.37
1982	22,297.5	4,797.9	83.4	-5.11	24.43
1983	19,998.1	4,262.3	114.0	-11.16	36.59
1984	18,847.8	4,523.0	195.0	6.12	71.05
1985	18,071.1	5,814.7	246.6	29.56	26.45
1986	17,478.3	4,712.0	306.6	-18.96	24.33
1987	16,680.9	4,377.7	311.8	-7.09	1.7
1988	16,027.4	4,320.9	372.9	-1.3	19.5
1989	15,849.9	4,303.2	492.1	-0.41	31.37
1990	15,134.4	4,375.1	463.1	1.69	-5.39
1991	15,636.3	4,405.5	476.0	0.69	2.79
1992	16,784.6	4,605.3	476.2	4.51	0.34
1993	16,055.9	3,937.2	486.7	-14.51	2.2
1994	16,614.5	4,255.3	589.8	8.87	21.13
1995	17,000.0	4,315.5	646.9	0.75	9.33
1996	17,265.2	4,303.1	662.6	-0.35	2.42
1997	17,972.6	4,337.4	698.6	1.95	5.4
1998	18,450.8	4322.4	756.3	-1.45	8.3

SOURCE: Central Statistical Office

* See Table on Exchange Rate Conversion

Indeed between 1982-1989 all of the companies located at Point Lisas experienced significant losses just under US\$1 billion. In fact by 1989, accumulated losses by ISCOTT alone were TTS2,000 million, while other companies such as Fertrin's (TTS377 million), TTMC (TTS70 million) and TTUC (TTS268 million) continued to experience losses. The NGC was the only company that realized a profit TTS228.8 million during the period, and has continued to experience significant profits in to the 1990's. There were several reasons for the dismal financial performance of these companies.

TABLE 13
NET FOREIGN EXCHANGE IN THE GAS-BASED SECTOR - 1985-1993
US\$ Million

COMPANY	1985	1986	1987	1988	1989	1990
	FOREX NET	FOREX NET	FOREX NET	FOREX NET	FOREX NET	FOREX NET
NGC	-3.5	-4.13	-5.6	-6.2	-5.4	22.9
TTUC	1.3	-2.3	0.69	30.3	31.4	28.3
TTMC	2.1	19.0	30.8	63.3	30.7	15.4
FERTRIN	-6.2	-42.4	-18.8	23.9	-52.7	3.3
TRINGEN	-14.9	-58.6	5.3	26.8	-3.8	-17.2
ISCOTT	-58.4	-26.1	-17.6	9.3	-36.7	-9.3
Net forex	-79.7	-114.1	-5.1	147.9	-36.4	43.4
	1991	1992	1993	1994	1995	1996
	FOREX NET	FOREX NET	FOREX NET	FOREX EARNINGS USAGE NET	FOREX EARNINGS USAGE NET	FOREX EARNINGS USAGE NET
NGC	53.6	75.3	51.2	n.a	n.a	n.a
TTUC	40.4	33.6	divested	n.a	n.a	n.a
TTMC	28.6	26.2	6.6	n.a	n.a	divested
FERTRIN	-16.2	-14.0	divested	n.a	n.a	n.a
TRINGEN	-6.6	-14.7	-8.7	n.a	n.a	n.a
ISCOTT	6.21	0.2	1.2	divested	n.a	n.a
Net forex	106.0	106.6	50.3	-	-	-

SOURCE: 6.6 (A)

TABLE 14
PROFIT/LOSS AFTER TAX OF THE STATE SECTOR
1982-1997
(TT \$Million)

COMPANY	1982	1983	1984	1985	1986	1987	1988	1989
NGC	22.3	25.1	43.2	(78.8)	41.6	40.7	63.9	70.8
TTUC*	-	-	-	(72.2)	(86.7)	(114.3)	9.8	(4.7)
TTMC*	-	-	-	(89.8)	(65.6)	(17.5)	82.0	21.1
FERTRIN	(86.8)	(32.2)	(41.9)	(117.9)	(32.2)	(9.9)	(32.0)	(24.2)
TRINGEN	(1.0)	(4.0)	6.0	12.9	12.2	12.3	28.9	(20.8)
ISCOTT	(262.0)	(377.0)	(196.0)	(271.7)	(227.6)	(258.2)	(293.0)	(195.6)
TOTAL	(230.2)	(-388.1)	(-188.6)	(-609.5)	(-358.3)	(-346.7)	(-140.5)	(-154.3)
	1990	1991	1992	1993	1994	1995	1996	1997*
NGC	112.5	126.7	51.1	133.3	367.0	345.1	353.7	350.0
TTUC*	2.7	32.1	3.4	divested	--	--	--	--
TTMC*	30.1	92.0	(7.2)	37.0	na	na	na	divested
FERTRIN	(2.9)	11.9	(47.5)	divested	--	--	--	--
TRINGEN	(2.8)	43.7	(11.6)	3.0	48.3	70.0	160.0	157.2
ISCOTT	(125.9)	(112.8)	(60.3)	20.0	--	--	--	--
TOTAL	13.8	193.7	(-72.0)	153.2	415.3	415.1	513.7	507.2

Source: Report on "Public Participation in Industrial and Commercial Activities," Ministry of Finance, 1985 and 1998

* These two companies were incorporated in 1985.

* This figure is a projected figure.

1. Given the capital intensity of these projects over the early years of the plant life there were significantly high debt and interest payments.
2. Some plants experienced significant cost overruns because of delays in construction. ISCOTT experienced delays which led to high cost overruns, while the mill's output averaged less than 30 (thirty) per cent of design capacity throughout the first five years of existence due to technical, marketing and managerial problems. The management of the company was inept at developing an ideal product mix that would have maximized the benefit from the plant's technical specifications. Added to this, the efficient operation of the plant was also affected by the poor managerial and technical skills that pervaded all levels of the organization. In effect, the cost of production was greater than the price of the final product. On the marketing side, there was a downturn in the international steel market, in addition, the company also faced a variety of restrictive trade barriers in the US and European Economic Community.
3. In the case of the methanol plant, TTMC, savings in the form of lower gas prices, lower insurance, a reduction in sales discounts, and lower contracted freight rates would have increased the profitability of the plant considerably.
4. The prices of ammonia and urea in the 1980's were relatively low (US \$100 per tonne and US \$120 per tonne respectively), which was not an adequate margin for debt service. In addition these plants came on stream when these fertilizer markets had entered into cyclical decline.

However the divestment process got underway just as the international markets began to rebound, and most of the plants were just at the end of the debt service period. The plants have been sold largely to foreign investors and Trinidad and Tobago's diversification efforts have been largely replaced, by foreign direct investment.¹⁹

Since 1982, the NGC has been a profitable entity as its earnings are derived from its function as the sole seller and transporter of natural gas as well as the 49 per cent shareholdings in the PPGPL. The NGC also has smaller investments as well as a 10 per cent interest in the soon to be completed Atlantic LNG plant. The company buys gas from Amoco as well as other gas producers, and sells to companies on the Point Lisas Estate. The profit derived is thus the difference between the buying and the selling price of natural gas. In addition, the company uses a market based pricing structure such that profits are affected by the market for end product. Hence, if there are downward movement in the prices of fertilizers, the price that the NGC charges must be adjusted downwards, leading to a fall in revenues. The company in its role as middleman, is subjected to major market risks, but despite this has realized profits in

each of the years under consideration, except in 1985 when major infrastructural developments were undertaken.

The Natural Gas-Based Sector Vs The Oil Sector : Contributions To The Foreign Exchange Earnings Of The Economy

Table 15 examines the foreign exchange earnings of the entire economy, the oil sector and the gas sector. The net foreign exchange earnings for the entire economy was calculated from cash flow estimates from the balance of payments, while the net foreign exchange earnings from the oil sector was computed using information from the balance of payments, company data submitted to the Central Bank of Trinidad and Tobago, and the financial statements of the oil companies. In 1981, net foreign exchange earnings for the entire economy amounted to US\$801.9 million following on the second oil shock in 1979. During 1982-1988 however, when oil prices declined drastically, trends in net foreign exchange earnings were reversed and these became negative. This country's high propensity to import goods as well as services also exacerbated the growth of the deficit. Net foreign exchange earnings for the oil sector peaked in 1981, at US\$2367.8 million but by 1993, this had fallen to US\$800.5 million. It must be noted however that while the net foreign exchange earnings from the oil sector have declined by more than 50 per cent, this is still considerably higher than earnings from the gas sector.

5. Increasing the Benefits of Natural Gas Based Industrialisation

From the discussions outlined in the previous sections it is clear that the vision outlined in the 1970's that gas-based industrialization would yield an increase in the net foreign exchange earnings and revenues has not been entirely realized. The newly established companies at the Point Lisas Industrial Estate have been built by using foreign direct investment and a strategy of fiscal incentives. Some commentators have argued that these incentives are too liberal and that there is need for a broad review of the fiscal incentives granted to both new and expanding companies in the energy sector. However one can also identify several factors that must be considered if any additional benefits from the gas-based

sector are to be realized over the medium term. These factors relate to natural gas pricing, the role of net back values, negotiating capability and depletion policy.

TABLE 15
NET FOREIGN EXCHANGE EARNINGS
US \$Mn

YEAR	ENTIRE ECONOMY	OIL SECTOR (DOMINANT SECTOR)	GAS-BASED (NEWLY CREATED SECTOR)
1977	n.a	1,278.4	--
1978	n.a	1,046.1	--
1979	n.a	1,525.5	--
1980	n.a	2,333.4	--
1981	801.9	2,367.8	--
1982	(125.0)	1,892.0	--
1983	(792.1)	1,549.7	--
1984	(498.5)	1,682.0	--
1985	184.4	1,650.2	-79.7
1986	(601.1)	964.1	-114.1
1987	(181.2)	1,000.5	-5.1
1988	(320.2)	830.3	147.9
1989	149.4	935.9	-36.4
1990	43.9	1,281.0	43.4
1991	(104.5)	1,095.9	106.0
1992	129.5	1,098.8	106.6
1993	282.6	800.5	50.3
1994	373.0	803.2	companies divested
1995	320.0	1,128.6	companies divested

SOURCE: Calculated from Company Reports, Financial Statements, and The Balance Of Payments.

V SECTION FIVE

Natural Gas Pricing

As a fuel with many uses natural gas has its highest value where it substitutes for petroleum products such as diesel fuel or kerosene. In many countries the small quantities that are needed to satisfy such uses fully are not enough to justify the high initial costs of natural gas development and transmission. Larger volume, but lower-value uses of gas are as replacements for fuel oil in the power and industrial sectors. Natural gas is also used as a feedstock for fertilizer or methanol production where the value of gas in these uses will vary with the world prices of these products. Thus, the relative value for gas will vary both over

time and across countries.

The production of natural gas is subject to large economies of scale, while investment in new capacity through new field development generally takes place in stages, thus there are periods between stages with relatively low short-run marginal costs. This suggests that gas available from an existing field is cheaper than gas from newly developed fields as the costs which must be incurred to bring new fields into production include development costs, costs for compression facilities and new pipelines. The costs of new pipelines varies with each new field development. These characteristics of natural gas as a commodity suggest that it is somewhat difficult to arrive at a market price for the commodity by the interaction of demand and supply forces.

Other considerations also include the following:-

- (i) natural gas is not a widely traded good because it is costly to transport, either by pipeline or as LNG. Countries that trade also face competition and other constraints to export expansion.
- (ii) while natural gas can act as a substitute for oil, it is not a perfect substitute. In some areas (home heating and electricity generation) natural gas and crude oil may be substitutable. For transportation purposes, however, gas is an expensive substitute for oil, while oil is a poor substitute for gas as a petrochemical feedstock. Because of this imperfect substitutability, the fuel oil-equivalent price of gas is not always an appropriate short-run estimate for the economic price of gas.
- (iii) gas is subject to price regulation in some countries for political or economic reasons. Governments may want to regulate production and distribution. As a result, prices might not reflect existing demand and supply conditions, because of the peculiar features of gas production. When exploiting non-renewable resources, authorities must therefore consider the influence of consumption foregone in the future, and in some cases a depletion premium is used in determining the gas price.

Because of these and other considerations different pricing structures have been used around the world. The four pricing structures used globally are: cost-plus pricing, market-based pricing, city-gate pricing and the hybrid approach. The *cost-plus* pricing formula requires an estimate of investments related to development, and an agreed profit margin. While this formula may provide maximum rent and low gas prices, it may not be related to the market price as the cost of production usually varies for different fields. One disadvantage of this

method however is that it does not cover all costs.

The *city-gate* pricing method requires that the government charge different prices to different consumers based on their ability to pay or their cost of distribution. This method is really a weighted moving average of the final prices to the consumer in a specific market, less distribution cost and margins. The major constraint of this method is the large amount of data required; this data would include the pricing of other fuels, volumes of gas supply and demand, investment costs, gas distribution regions, possible gas usage, and the price of downstream products.

The *market-based* method which is used in Trinidad and Tobago relates prices to the final consumer in the market, or city gate prices at the outlet or transmission pipeline. The major advantages of this method are that it allows for adjustments between field prices and city-gate prices and assists the long term development of the industry. One disadvantage of the approach is that the field value of gas may vary with cost and profitability.

As the name suggests, the *hybrid* method is a mixture of the three methods and is an attempt at correcting the flaws of these methods. The hybrid approach incorporates a high degree of flexibility which seems to capture the benefits of the other three approaches. The National Gas Company in Trinidad and Tobago has a dual system for natural gas pricing. For consumers at the petrochemical plants the price of natural gas is a product related structure which fluctuates between a floor and a ceiling price depending on the international prices of fertilizers and methanol. However the NGC charges the iron and steel industry a fixed price with an escalator clause.

Netback values

Following Julius and Mashayekhi (1990), any country embarking on a natural gas based development strategy should determine the maximum netback value in each of the potential natural gas markets. The netback value involves the comparison of the total expenses

(capital expenses, operating fixed and variable costs) that a particular consumer would have to incur when using for any particular application a competing fuel, (oil) instead of natural gas. The most straightforward example is when gas is used in place of an alternative fuel or feedstock for domestic production of fertilisers. In this case, the total benefits attributable to gas are equal to the total cost of the alternative fuel or feedstock over the life of the project less the difference in investment or conversion costs of the two processes. It is convenient to express the gas benefit in terms of a benefit per unit of gas consumed over time. This is referred to as the "netback value" of gas in that use. Calculating netback values is important because the procedure allows one to rank projects on technical and economic grounds so that those projects in which natural gas yields the highest benefit are implemented.

For future gas projects, the GOTT needs to keep in mind the market for the commodities currently produced and attempts should be made to provide incentives for more downstream industries in which to diversify operations. Since this country is a major producer and exporter of petrochemicals, overproduction in one or more of these commodities will depress prices and in turn revenues, both to the producers and to the GOTT.

Need for a Determination of The Reserve Base and A Depletion Policy

By the year 2000, it is expected that production and utilization of gas will increase to approximately 1562 mmcf/d. Given the success in accelerating the rate of investment in the gas sector and the projects that are slated to come on stream, (a US\$990 million aluminium smelter and a second and third LNG train) gas utilization and production will double within the next decade to approximately 3,124 mmcf/d.

Because of the accelerated pace of consumption and production there is an urgent need for an appropriate depletion policy, as well as an assessment of the reserves, acreage and fields that may contain gas to satisfy the growing market. A country has a fixed stock of natural resources and consumption of one mmcf today implies foregone consumption of a mmcf at some future date, with the value of this foregone consumption called the depletion premium.

To date policy makers have ignored the need for enunciating an appropriate depletion policy to deal with future extraction rates, production to reserves ratio, resource base and production rate.

Developing a Negotiating Capability

The GOTT gets revenues from the taxes and royalties it collects from the gas producers (upstream), consumers (downstream) and from revenues obtained from the NGC through gas sales. In addition, Petroleum Production Levy (which applies only to the production of oil), Surface Related Lease Charges, Petroleum Profit tax and a Supplemental Petroleum Tax (which also applies only to the production of oil), are all instruments by which the GOTT collects its revenues. The revenue derived from the producers are directly related to the contractual arrangements (licenses) *negotiated* between the GOTT and the producers. Companies produce gas under licensing agreements and pay royalties *negotiated* individually between each producer and the GOTT. Some commentators argue that the negotiators for the government do not usually bargain from a position of strength. If the state intends to maximize the returns from natural gas there is a strong possibility that there is a need to re-negotiate contracts, licenses and leases where necessary.

Fiscal Incentives

Since government's revenue from the gas-based sector is today largely dependent on taxes paid by the companies it is important to examine the rationale and the need for fiscal incentives. First, energy sector plants are capital intensive and often have long debt repayment periods, they require long lead times from construction to start up of production, and often must experience huge cash outlays before there is any significant revenues. The nature and type of commodities that are produced are often subjected to volatile market forces, thus there is the need for some form of protection. Incentives also encourage investors to develop certain designated areas, as well as introduce new and emerging technologies to host countries.

Considering the above, fiscal incentives should therefore provide an adequate return to

industry, and at the same time they should also provide a fair return to host country. A critical issue is whether the state benefited fully by way of net foreign exchange earnings, employment and revenues, given all the fiscal incentives granted to companies in the energy sector. Preliminary evidence suggests that in the case of Trinidad and Tobago, the benefits to the state were minimal.

Future projects and project expansion also require immediate attention as many companies that are undergoing expansions have been granted tax holidays. The expansions are being undertaken by associated companies, thus there is a sharing of personnel, administration and infrastructure. In this regard the opportunity arises for the new entity to allocate as much as is possible of the common infrastructure expenditure to the tax paying entity, which in turn allows maximum profits to accrue to the tax holiday entity.¹¹

It is imperative at this point however, to examine briefly the incentives offered to petroleum companies under the Fiscal Incentives Act, 1979, and the Income Tax Act, 1950. Both Acts have profound implications for the amounts of income and corporation taxes which the government receives. The Income Tax Act sets out the way in which tax depreciation is computed and allowed as a deduction. Under the Fiscal Incentives Act companies are granted total or partial relief from corporation tax and customs duty, as well as loss offset without limitation. The Act also specifies tax holiday periods (5, 7 or 10 years), and grants total and partial relief from income tax on dividends or other distributions out of the gains and profits during the tax holiday period. The Fiscal Incentives Act also allows relief from customs and other import duties.

Despite the experiences of the past these concessions and incentives continue to be granted to the new petrochemical companies without a proper consideration as to whether these concessions are necessary today (Table A.6). There is little evidence to suggest that any attempts have been made to do a proper evaluation of the projects¹² so that one might be able to ascertain whether fiscal incentives should be granted to each and every project. The mature state of the industry implies that incentives should be geared and tailored to the further

downstream industries instead of the primary petrochemical producers.

There is little or no specification in the Fiscal Incentives Act whether total or partial relief from corporation or customs duty is to be granted. In fact, most plants are arbitrarily given these free concessions as well as a five year tax holiday such that when one incentive is exhausted, (e.g. the tax holiday), there is nothing to stop the company from making use of one of the other incentives, (e.g. the grant of an export allowance). This process enables a company exporting all of its output to evade the payment of corporation tax for its entire period of operation.

The question also arises as to whether the GOTT should offer partial relief instead of total relief from corporation taxes and customs duties. There is an immediate need for the relevant authorities to make policy guidelines to establish a criterion by which fiscal incentives should or should not be granted.

Over the next three years, given the concessionary fiscal incentives, the construction of new plants, as well as the expansion of the existing plants, it is expected that tax revenues from the sector will be in decline, despite the rapid pace of activity in the sector. If revenues are to be enhanced it is critical at this time for the GOTT to review the Fiscal Incentives Act and the Income Tax Act with regard to the energy sector.

CONCLUSIONS

In summary, preliminary evidence suggests that the plants built with government equity did not yield substantial benefits for the economy of Trinidad and Tobago. Today the plants are no longer built with government equity, but largely by foreign investors so that the government collects just taxes and royalties from the sector. Our preliminary analysis suggests that there is urgent need for a cadre of professional negotiators as well as a review of the gas prices. In addition, the fiscal incentives offered should be geared to new downstream industries, and not just to the primary producers alone. If the country continues to monetize gas resources as

rapidly and as successfully as it has been doing over the past five years and the coming years, it is imperative that the issue of pricing, fiscal incentives, netback calculations and depletion policy becomes part of the government's gas sector planning process.

ENDNOTES

- 1 Most of the gas-based development is concentrated in this Estate.
- 2 Trinidad and Tobago, 1981, *White Paper on Natural Gas*, Ministry of Energy and Energy Industries.
- 3 Trinidad and Tobago, 1987, *Energy Policy for Trinidad and Tobago: A Draft*, Ministry of Energy and Energy Industries.
- 4 Trinidad and Tobago, 1981, *White Paper on Natural Gas*, Ministry of Energy and Energy Industries.
- 5 Trinidad and Tobago, November 1992, *Energy Policy for Trinidad and Tobago: A Draft* Ministry of Energy and Energy Industries.
- 6 This was announced in January 1997 by the Minister of Energy and Energy-based industries.
- 7 In reality, by 1997 the Government of Trinidad and Tobago had divested all the petrochemical companies (and the iron and steel company) except for a 51 per cent shareholding in Tringen. The GOIT still owns the NGC, which has a 49 per cent shareholding in the Phoenix Park Gas Processors Limited (PPGPL). In 1998 however, the PPGPL is expected to be divested.
- 8 Information obtained from discussions with industry officials.
- 9 The majority of the companies have been sold to foreign investors. However CLICO, a local conglomerate now owns approximately 75 per cent of the methanol concerns in Trinidad and Tobago.
- 10 These charges paid under both the licences and the production sharing agreements, increases the longer the area remains unused for oil or gas production. However, as soon as production begins, these fees can be subtracted from the total royalties that are paid.
- 11 See "Report on Fiscal Incentives for the Petroleum Industry" Unpublished Report of the "Technical Advisory Group to the Energy Sub-Committee of Cabinet, 1997.
- 12 A proper evaluation of the projects will inevitably take into account capital costs, location, permanent employment and whether these will be affected substantially by the incentives granted

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ABBREVIATIONS

Amoco	American Oil Company
Bbl	Barrel
Bcf	Billion cubic feet
Bcm	Billion cubic metres
BP	British Petroleum
CCGT	Combined Cycle Gas Turbine
CIS	Commonwealth of Independent States
CNG	Compressed Natural Gas
DRI	Direct Reduction Iron
ECMA	East Coast Marine Area
EMF	Energy Modeling Forum
Fedchem	Federation Chemicals Limited
FERC	Federal Regulatory Commission
FSU	Former Soviet Union
GDP	Gross Domestic Product.
GOTT	Government of Trinidad and Tobago.
GTG	Gas to Gasoline.
ISCOTT	Iron and Steel Company of Trinidad and Tobago.
LNG	Liquefied Natural Gas.
LPG	Liquefied Petroleum Gas.
Mcf	Thousand cubic feet (= 28.3 cubic feet).
Mmcfd	Million cubic feet per day.
MTBE	Methyl tertiary butyl ether.
NGPA	Natural Gas Policy Act.
NIHERST	National Institute of Higher Education, Research, Science and Technology.
NGC	National Gas Company.
PLIPDECO	Point Lisas Industrial Port Development Corporation.
PPGPL	Phoenix Park Gas Processors Limited.
SEG	South East Galeota.
SECC	South East Coast Consortium.
SPE	Society of Petroleum Engineers.
TCL	Trinidad Cement Limited.
Tringen	Trinidad Nitrogen Company Limited.
TT	Trinidad and Tobago.

ABBREVIATIONS (cont'd)

TTEC	Trinidad and Tobago Electricity Commission.
TTMC	Trinidad and Tobago Methanol Company
TTOC	Trinidad and Tobago Oil Company.
TTPC	Trinidad and Tobago Petroleum Company.
TTUC	Trinidad and Tobago Urea Company
UK	United Kingdom.
US	United States.
UWI	University of the West Indies.

TABLE A1
TYPICAL CONSTITUENTS OF NATURAL GAS

COMPONENT	AMOUNT	GROUP DESCRIPTION
PARAFFINIC HYDROCARBON (N²+2)		
Methane (CH ₄)	70-98%	Dry Gas
Ethane (C ₂ H ₆)	1-10%	Dry Gas
Propane (C ₃ H ₈)	Trace - 5%	Dry Gas, LPG
Butane (C ₄ H ₁₀)	Trace - 2%	LPG, NGL
Pentane (C ₅ H ₁₂)	Trace - 1%	NGL
Hexane (C ₆ H ₁₄)	Trace - 0.5%	NGL
Heptane & higher (C ₇ +)	None - Trace	NGL
CYCLIC HYDROCARBONS		
Cyclopropane	Traces	
Cyclohexane	Traces	
Aromatic hydrocarbon		
Benzene C ₆ H ₆	Traces	
Others	Traces	
NON HYDROCARBON (IMPURITIES)		
Nitrogen (N ₂)	Trace 1.5%	
Carbon dioxide (CO ₂)	Trace 0.1%	
Hydrogen sulphide (H ₂ S)	Trace occasionally	
Helium (He)	Trace 0.5%	
Other sulphur and nitrogen compounds	Trace occasionally	
Water	Trace 0.5%	

SOURCE: New York: UNDTCD, 1991

TABLE A2
TRADE MOVEMENTS 1996 - LNG*

TO	USA	UAE	Algeria	Libya	Australia	Brunei	Indonesia	Malaysia	Total Imports
North America	-	0.2	1.0	-	-	-	-	-	1.2
USA	-	-	-	-	-	-	-	-	-
Europe	-	-	4.0	-	-	-	-	-	4.0
Belgium	-	+	7.6	-	-	-	-	-	7.5
France	-	0.2	4.0	1.2	+	-	-	-	6.9
Spain	-	0.9	2.2	-	0.1	-	-	-	2.3
Turkey	-	-	-	-	-	-	-	-	-
Asia Pacific	-	-	-	-	10.0	7.7	25.6	12.0	63.8
Japan	1.0	6.0	-	-	0.1	1.0	0.5	3.5	13.0
South Korea	-	-	-	-	-	-	2.0	1.4	3.4
Taiwan	-	-	-	-	-	-	-	-	-
TOTAL EXPORTS	1.8	7.4	19.6	1.2	10.1	8.7	35.9	17.7	102.4

SOURCE: CEDIGAZ

* Liquefied Natural Gas
+ Less than 0.05

TABLE A4
TOTAL EMPLOYMENT AND PERSONS EMPLOYED
IN THE OIL AND GAS SECTOR

YEAR	TOTAL EMPLOYMENT	EMPLOYMENT IN OIL SECTOR, EXPL., PROD., & REF.	EMPLOYMENT IN ISCOTT AND PETROCHEMICALS
1977	-	11,232	232
1978	390,100	11,686	711
1979	400,000	11,805	700
1980	387,900	11,444	690
1981	389,600	11,288	1,962
1982	401,000	10,672	2,032
1983	399,400	9,472	2,063
1984	406,800	9,199	2,042
1985	399,600	8,538	1,759
1986	390,900	8,690	1,969
1987	372,600	9,470	1,866
1988	371,600	7,557	1,951
1989	365,700	7,047	1,367
1990	374,100	6,120	1,945
1991	401,100	6,320	1,997
1992	405,900	6,833	1,966
1993	404,600	6,421	1,945
1994	415,500	6,195	1,337
1995	431,600	5,699	1,329
1996	444,200	5,856	1,379
1997*	465,900	na	1,879

SOURCE: Central Statistical Office.

* Figures for 1997 are for the period January-September.

TABLE A3
TRADE MOVEMENTS, 1996 BY PIPELINE - FROM

T.O.	USA	Canada	Mexico	Bolivia	Denmark	Germany	Netherlands	Norway	UK	FSU	Oman	Algeria	Malaysia	Total Imports
North America	-	80.1	0.4	-	-	-	-	-	-	-	-	-	-	80.5
USA	1.3	-	-	-	-	0.6	-	0.6	-	6.1	-	-	-	7.2
Canada	-	-	-	-	-	0.7	6.0	4.1	-	6.2	-	-	-	10.3
Mexico	0.9	-	-	-	-	-	-	-	-	16.6	-	-	-	6.2
S. & Cont. America	-	-	-	2.0	-	-	-	-	-	3.0	-	-	-	16.6
Algeria	-	-	-	-	-	-	-	-	-	12.1	-	-	-	3.0
Europe	-	-	-	-	-	0.9	6.5	10.9	-	33.3	-	-	-	20.5
Austria	-	-	-	-	-	-	20.3	16.2	1.2	7.2	-	-	-	78.0
Belgium	-	-	-	-	-	-	4.5	-	0.3	14.0	-	19.0	-	7.2
Bulgaria	-	-	-	-	-	-	0.7	-	-	-	-	-	-	0.3
Czech R. & Slovakia	-	-	-	-	-	-	0.7	-	-	-	-	-	-	0.3
Finland	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7
France	-	-	-	-	-	-	-	-	-	-	-	-	-	3.0
Germany	-	-	-	-	-	-	-	-	-	-	-	-	-	3.0
Greece	-	-	-	-	-	-	-	-	-	-	-	-	-	7.3
Hungary	-	-	-	-	-	-	-	-	-	-	-	-	-	7.3
Ireland	-	-	-	-	-	-	-	-	-	-	-	-	-	7.4
Italy	-	-	-	-	-	-	-	-	-	-	-	-	-	7.4
Luxembourg	-	-	-	-	-	-	-	-	-	-	-	-	-	2.6
Netherlands	-	-	-	-	-	-	4.5	-	0.3	-	-	-	-	2.6
Norway	-	-	-	-	-	-	0.7	-	-	-	-	-	-	0.9
Poland	-	-	-	-	-	-	-	3.5	-	-	-	-	-	2.7
Romania	-	-	-	-	-	-	-	-	-	-	-	-	-	6.7
Spain	-	-	-	-	-	0.9	-	-	-	-	-	-	-	1.8
Sweden	-	-	-	-	-	-	-	-	-	-	-	-	-	1.8
Switzerland	-	-	-	-	-	-	-	-	-	-	-	-	-	1.8
Turkey	-	-	-	-	-	1.6	0.7	-	-	-	-	-	-	1.8
United Kingdom	-	-	-	-	-	-	-	1.8	-	-	-	-	-	1.8
Middle East	-	-	-	-	-	-	-	-	-	-	0.3	-	-	0.3
United Arab Emirates	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3
Africa	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1
Tunisia	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1
Asia Pacific	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5
Singapore	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5
TOTAL EXPORTS	2.2	80.1	0.4	2.0	1.8	2.9	40.7	30.1	1.9	123.9	3	21.2	1.5	321.8

SOURCE: CEDIGAZ

TABLE A5
TOTAL EMPLOYMENT AND PERSONS EMPLOYED
IN THE OIL AND GAS SECTOR
(percent)

YEAR	% EMPLOYMENT IN OIL	% EMPLOYMENT IN ISCOTT AND PETROCHEMICALS
1978	2.9	.18
1979	2.9	.17
1980	2.9	.17
1981	2.8	.50
1982	2.6	.50
1983	2.6	.51
1984	2.2	.50
1985	2.1	.44
1986	2.2	.50
1987	2.5	.50
1988	2.0	.52
1989	1.9	.51
1990	1.8	.51
1991	1.5	.49
1992	1.6	.48
1993	1.5	.43
1994	1.5	.44
1995	1.3	.44
1996	1.3	.42

SOURCE: Table 15

TABLE A6
INCENTIVES GRANTED TO COMPANIES IN THE ENERGY SECTOR

COMPANY NAME	PRODUCTS MANUFACTURED	INCENTIVES GRANTED	EFFECTIVE DATE	STATUS
Phoenix Park Gas Processors Limited	Propane, butane and natural gasoline	<ul style="list-style-type: none"> * Exemption from VAT * Five (5) year corporate tax holiday * Import duty concessions 	June 01 1991	In operation
Caribbean Ispat Limited	Direct reduced iron pellets, steel billets and steel wire rods	<ul style="list-style-type: none"> * Exemption from VAT * Import duty concession for a period of seven (7) years 	Jan. 01 1993	In operation
Caribbean Methanol Co. Limited	Methanol	<ul style="list-style-type: none"> * Exemption from VAT * Five (5) year corporate tax holiday * Import duty concessions * Loss-offset 	July 01, 1993	In operation
Trinidad and Tobago Methanol Company Ltd. 1 & 11	Methanol	<ul style="list-style-type: none"> * Exemption from VAT on imports * Five (5) year corporate tax holiday * Exemption from Stamp Duty on items for the construction of the plant * Import duty concessions * Loss-offset 	Mar. 10 1996	In operation
Atlantic LNG CO. of Trinidad and Tobago	Liquefied natural gas and a stream of natural gas liquids	<ul style="list-style-type: none"> * Exemption from VAT on imports * Ten (10) year corporation tax holiday * Import duty concessions * Relief from withholding tax. 	Dec. 01 1999	Under construction
Titan Methanol Company Co. Trinidad	Methanol	<ul style="list-style-type: none"> * Exemption from VAT on imports * Five (5) year corporation tax holiday * Import duty concessions * Relief from withholding tax. 	Aug. 31 1998	Under construction
Arcadian (Now PCS) 03 Plant	Anhydrous Ammonia	<ul style="list-style-type: none"> * Exemption from Vat on imports * Five (5) year corporation tax holiday * Import duty concessions * Loss offset 	Feb. 02 1996	In operation

TABLE A6
INCENTIVES GRANTED TO COMPANIES IN THE ENERGY SECTOR
(Continued)

COMPANY NAME	PRODUCTS MANUFACTURED	INCENTIVES GRANTED	EFFECTIVE DATE	STATUS
Arcadian (Now PCS) 04 Plant	Anhydrous Ammonia	<ul style="list-style-type: none"> * Exemption from VAT on imports * Five year corporation tax holiday * Import duty concessions * Relief from withholding tax 	Apr. 30 1993	In operation
Methanol IV	Methanol	<ul style="list-style-type: none"> * Exemption from VAT on imports * Five (5) year corporate tax holiday * Import duty concessions 	Apr. 01 1993	In operation
Cleveland Cliffs & Associates Limited	Methanol	<ul style="list-style-type: none"> * Exemption from VAT on imports * Five (5) year corporate tax holiday * Import duty concessions * Loss-offset 	Jun. 01 1993	In construction
Fairland Mississippi Ltd.	Anhydrous Ammonia	<ul style="list-style-type: none"> * Exemption from VAT on imports * Seven (7) year corporation tax holiday * Import duty concessions * Relief from withholding tax 	Sept. 01 1993	Under construction.

SOURCE: Central Bank of Trinidad and Tobago.

TABLE A7
NATURAL GAS CONVERSION TABLE

	cubic metres of gas
1 cubic metre gas =	1
1 cubic feet =	0.02832
1 cubic metre LNG =	584
1 tonne LNG =	1379
1 bbl crude =	152
1 tonne crude =	1111
1 tonne LPG =	1250
1 bbl LPG =	106
1 metre Btu =	27.8

SOURCE: BP Review Of World Gas, 1997.

TABLE A8
 CURRENCY EQUIVALENTS/EXCHANGE RATE CHANGES
 \$T/\$US

YEAR	EXCHANGE RATE
1984	US \$1.00 = TT2.40
1985	US \$1.00 = TT3.60/2.40 (dual rate)
1987	US \$1.00 = TT3.60 (unified rate)
1988	US \$1.00 = TT4.25
1993	US \$1.00 = TT5.76 (floatation)
1994	US \$1.00 = TT5.93
1995	US \$1.00 = TT5.99
1996	US \$1.00 = TT6.24
1997	US \$1.00 = TT6.29

SOURCE: Central Bank of Trinidad and Tobago.