OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

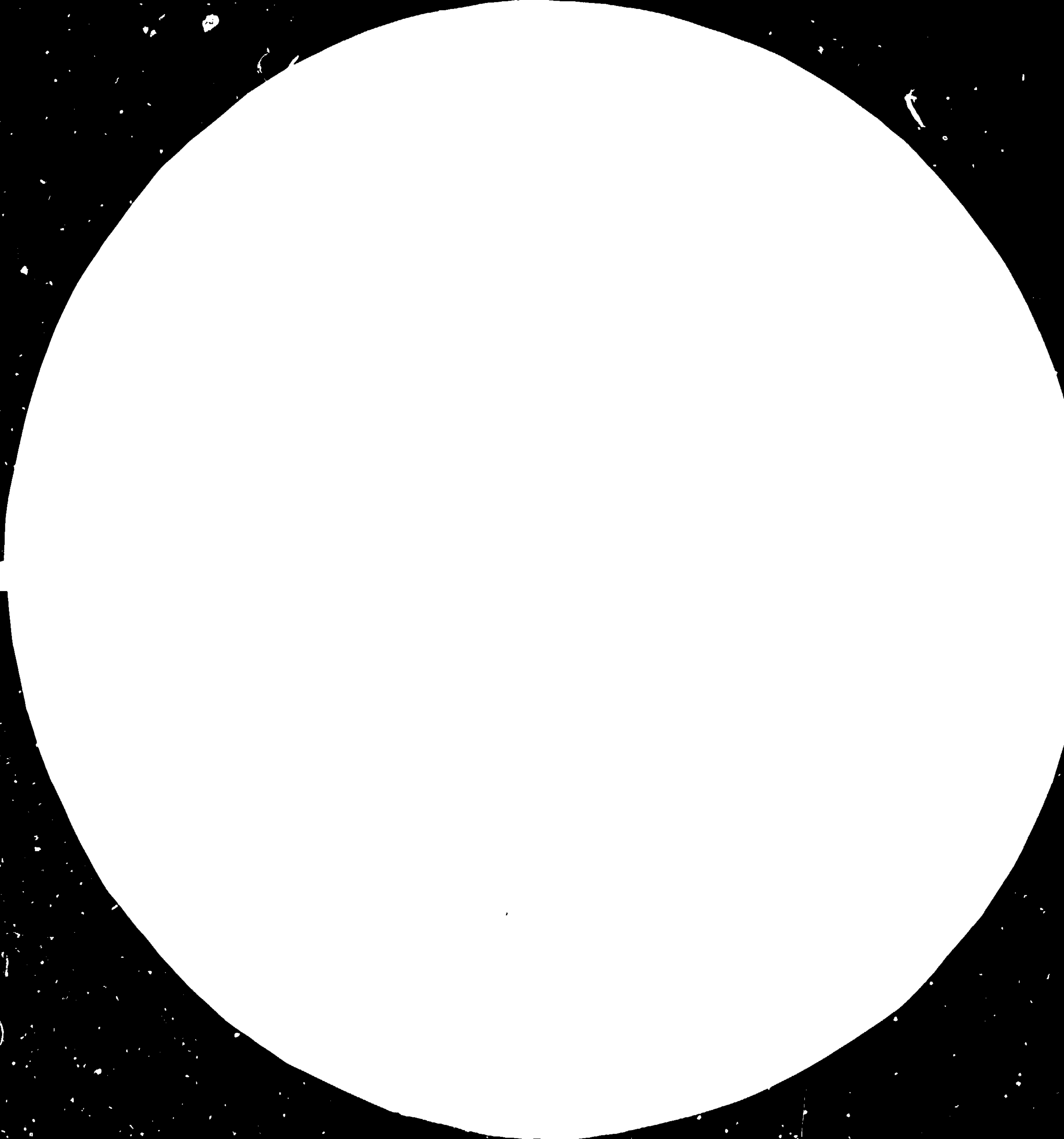
FAIR USE POLICY

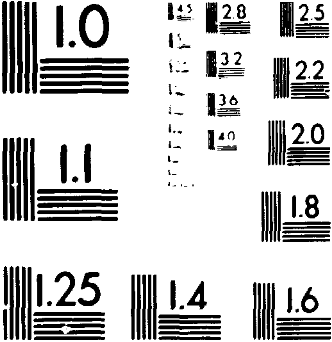
CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org





MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS

STANDARD REFERENCE MATERIAL 1010a

(ANSI and ISO TEST CHART No. 2)

13909

Distr.
LIMITED

UNIDO/IS.482
28 August 1984

ENGLISH

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

ENERGY-INTENSIVE INDUSTRIALIZATION IN THE MIDDLE EAST

Third World Opportunities *

prepared by

Dr. Thomas R. Stauffer
Diplomatic Academy, Vienna

2597

* The views expressed in the paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. The designations employed and the presentation of material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This document has been reproduced without formal editing.

V.84-89894

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

ENERGY-INTENSIVE INDUSTRIALIZATION
IN THE MIDDLE EAST:

Implications for the Third World

I. INTRODUCTION

This report focuses on the prospects for further energy-intensive industrialization in the oil-exporting countries of the Middle East, with particular reference to the major oil-exporters of the Gulf and to the possible implications of this industrialization programme for other countries of the Third World.

The longer-run scope for such industrial development in the Middle East is large, but today the constraint upon future expansion is neither economics nor markets but rather -- the pending shortages of commercialisable gas in many of the key oil producers. The comparative advantage of the Middle East oil exporters in many basic industries is now absolute -- their production costs are the lowest in the world in most energy-intensive sectors; the current issue in most oil-exporting countries is selecting the most valuable uses for their limited gas resources. All options are feasible, but some offer higher netbacks than others, and it is now imperative that those yielding the highest rents be identified, given that gas is scarce.

The potential comparative advantage of the oil-exporting states in heavy industry is very real. It lies precisely in those industrial sectors which are either capital or energy-intensive and which are presently faring least well in the OECD states. This implies over the longer run that there may be major shifts in the location of basic industry.

The beginning of this trend is already apparent, and the oil-exporting states since the mid-1970's have been expanding capacity in those sectors where the industrial states of the North are finding themselves compelled to rationalise, to mothball, and to retrench. Highly compeitive basic industries are emerging in the Middle East -- primary metals, oil refining, basic petrochemicals, and certain industrial chemicals.[1/]

This "reverse wave" industrialization — emphasising export-oriented heavy industry instead of the more customary light and intermediate industry oriented towards import substitution -- is a significant step in the industrialization of the "South". It also introduces certain opportunities for intensified "South-South" economic cooperation, but, simultaneously, it also creates new forms of competition for existing industries in some of the Newly Industrializing Countries (NICs) and thus is a new element in intra-South competition.

We shall analyse the scope for such industrial projects in the oil-rich states from several standpoints. We focus first on the oil-exporters themselves and the implications of gas-based industry for them. The principal thrust of the following discussion is an explanation of the new economics of gas for basic industry, indicating why such industry today is eminently profitable whereas only ten years ago it was not.

Derivatively we shall also indicate the implications of industrialization by the oil-exporters for industrial trends within the broader context of the "South". In particular, we shall note the possible impacts upon a broad class of developing countries including not only the NICs but also those countries which potentially supply labour, contractors, and raw materials. At the same time it is also necessary to highlight those areas where such new industries will compete with similar plants in other developing countries -- a dimension of intra-South competition which offsets some of the complementarities.

The assessment consists of the following parts:

II. Background: industrial development strategies and objectives in the Middle East.

III. Opportunity cost of capital -- the implications of capital availability for both low and high-absorbing oil-exporting countries.

IV. Availability and evaluation of natural gas.

V. Structure of value-added in energy-intensive sectors; the measures of potential profitability and relative economic ranking of various industrial options.

VI. Complementarities with developing countries (NICs); opportunities for cooperation, and areas of potential competition.

II. INDUSTRIAL DEVELOPMENT STRATEGIES IN THE MIDDLE EAST: BACKGROUND

The interest in industrial development in the Middle East is not new; the oil-exporters share the desire of all producers of raw materials to add more value domestically to their exports of natural resources by integrating downstream into semi-finished and finished products.

This objective has become realisable, however, on a significant scale only since 1973, following upon the first quantum jumps in the real price of oil. Prior to 1973, the cost of energy was so low, that even free natural gas did not offset the other cost disadvantages of the oil-exporters. Energy-intensive projects in the Middle East during that early period were comparatively rare and, if undertaken, were oriented towards the domestic market.

The few examples, other than the export refineries built by the multinational companies (MNCs) (Abadan in Iran, Ahmadi in Kuwait, and Ras Tanura in Saudi Arabia), usually proved unprofitable. The Shuaiba refinery in Kuwait and the Saudi Arabian Fertiliser Company (SAFCO), both initiated in the 1960s, were classic cases of premature ventures which were, until 1973/74, at best marginally profitable.

Previously, prior to 1973, the economics were consistently unfavourable. Industrial projects needed to be justified on strategic grounds or rationalised as contributing intangibly to broader objectives of diversification. Since 1975, and especially since 1980, they are economically viable without recourse to such non-economic justifications.

The economics of these industries changed radically after 1973, when higher oil prices led to higher energy prices more generally. The four to five-fold increase in overall energy costs created an economic umbrella for gas-based industries in the Gulf and then raised the umbrella high enough to offset start-up costs, extra infrastructural requirements, and other disabilities.

Important new opportunities were created, because the price of oil had risen high enough that energy-intensive projects in the OPEC states could compete with oil-fueled projects elsewhere. Since gas was so cheap, newer gas-based projects were able to yield a net, positive value for the natural gas, over and above a reasonable rate of return on the invested capital, in spite of higher capital and operating costs than their OECD-based competitors.

The new ethos was summarised crisply by the Saudi Finance Minister, Mr. Aba-Khail, in his characterisation of the objectives of Saudi Arabia's plan for basic industries:

> "Its thrust will be aimed at diversifying our economies by helping to create a line of industries in which we, as oil producers and capital exporters, enjoy a comparative advantage."[2/]

Throughout the oil-exporting countries, one has seen in the past ten years a rapidly growing number of basic industrial projects, reversing the usual priorities for industrial development and reflecting the special factor endowments of the oil-exporters.

Their comparative advantage lies in the relative availability of both capital and natural gas, and the rapid industrial expansion of the past ten years has reflected this economic advantage (see Table 1). As of 1982 total refining capacity in the Organization for Arab Petroleum Exporting Countries (OAPEC) states amounted to 3.3 mmb/d and another 2.9 mmb/d was under construction. The OAPEC states' refining capacity by ca. 1987, when all plants will be on stream, will amount to about 15% of total consumption of refined products outside of the CPE's.

The expansion in manufacture of ammonia-based fertilisers has been no less dramatic; total capacity will reach almost 9 million tonnes p.a. later in this decade and, as is the case also with refined products, will represent a much larger fraction of total world trade. Ammonia or urea from the Gulf is especially competitive since, except for the U.S. and several developing countries which enjoy gas deposits, most ammonia manufacture in the world is based upon naphtha derived from crude oil, and the cost margin in favour of the Gulf producers ensures their markets.

Ethylene production is expanding even more rapidly, albeit with a slower start, and plants already under construction in the OAPEC area will alone

Table 1 — ENERGY-INTENSIVE INDUSTRIES: PRESENT AND PROSPECTIVE (OAPEC States)

	Existing	Underway	Proposed	Total
Refineries (mmb/d)	3.3	1.8	1.1	6.2
Ethylene (mmT/y)	0.5	2.5		3.0
Methanol (mmT/y)	0.4	1.9		2.3
Ammonia (mmT/y)	4.4	4.1		8.5
Aluminium (mmT/y)	0.4	0.3		0.7
Steel (DRI) (mmT/y)	2.3	1.4		3.7

Sources: OAPEC annual reports, except:
Aluminium: Stauffer, op. cit.
Steel: Metals Bulletin, various ISSUES

Note: mmb/d = million barrels per day
mmT/y = million tons per year

contribute 3 million tonnes to world supply within some 5 years. Here, too, the competitive edge is clear, since three-quarters of all ethylene, outside of OPEC states, is derived from naphtha or natural gas liquids, the prices of which (except in the US) carry a premium over crude oil, giving a clear comparative advantage to the Middle East producers. The status of still further additional ethylene capacity in the area is uncertain, since construction of two large complexes in Iran and Iraq has been indefinitely interrupted by the war in the Gulf, and both facilities are understood to have suffered considerable damage.

Cement is another sector which experienced very rapid growth in the 1970's; in Saudi Arabia, for example, domestic production has increased almost eight-fold since 1970, and the Gulf, once a major market for imported cement, is now essentially self-sufficient.

The oil-exporting countries' interest in fostering industrial development, especially the basic industries, is widespread, but consistent or systematic policies are in fact rare. With the striking exception of Saudi Arabia the expansion of basic industries involved ad hoc decisions taken on a case-by-case basis as opportunities were identified and as proposals were presented

Broadly, however, all governments availed themselves of some mix of the following instruments to promote or facilitate heavy industry:

- Modest tariff protection for domestic industry.
- Preferential purchasing of domestic output by government agencies or contractors.
- Concessional financing for industrial projects, both for domestic market and export.
- Provision of extensive infrastructure, either free or at very low cost.
- Supply of electricity and water at highly subsidised rates.
- Flexible pricing of natural gas.

Tariff protection and preemptive purchase clauses were of limited importance to the basic industries, but the availability of low-priced energy and utilities were major factors in overcoming initial barriers to the establishment of the larger industrial ventures.

Common to all major, gas-based industrial projects in the Middle East were two pervasive considerations:

- maximise domestic value-added from the exhaustible resource
- eliminate flaring of natural gas

Beyond this quite universal interest in commercialising flared gas, there emerged several marked differences in the approaches to industrial development. The states evolved rather different strategies with regard to three important aspects of their industrialization programmes: 1) extent of project integration; 2) modes of participation with foreign partners or the domestic private sector; and 3) the mechanics of pricing gas to the enterprises.

1. Project Integration

Although all countries issued broad, quite general plans concerning industrial development, the industrialization objectives were most systematically articulated in the case of Saudi Arabia, where a comprehensive master plan for the establishment of basic manufacturing industry was conceived and then implemented as an integrated programme.

Central to the Saudi programme was the creation of a extra-ministerial, independent authority with full responsibility for designing and implementing the projects cum infrastructure, and the Royal Commission for Jubail and Yanbu, whose director had ministerial rank, was established to this end in 1975.

The scheme involved creating two virtually self-contained industrial parks at the ports of Jubail in the Eastern Province and Yanbu on the Red Sea. Not only the industrial facilities themselves but all the requisite infrastructure were included within the scope of the Master Plan. The scheme was predicated upon basic industries, but also envisaged secondary industries such as intermediate petrochemicals derived from the ethylene plants and also a broad range of tertiary support industries, since the complexes were large enough to support such a base.

The infrastructure was an integral part of the plan and was designed in advance to encompass the full spectrum of primary, secondary and tertiary industries. Unlike industrial projects elsewhere, it was not plant-specific but provided simultaneously the common support services and sites for a diversified complex of industries.

The potential joint economies of such an integrated scheme were large, but it entailed a massive mobilisation of both planners and contractors. Both Jubail and Yanbu were minor dhow harbours prior to the inception of the projects in 1975, so that the Saudi programme had to create the full panoply of support structures -- all the requisite housing, schools, and social services for two self-contained communities aggregating over 250,000 population and allowing for expansion by the year 2000-plus to close to 400,000.

2. Autonomy versus partnership

The most notable difference lies in the role assigned or permitted to foreign partners, which ranges from 50-50 participation between foreign companies and the government in joint ventures, on one hand, to the extreme autonomous model where the state owns 100% of the industrial operations, on the other.

Saudi Arabia elected the participation model, and all of the major heavy industrial projects in the Kingdom are 50-50 joint ventures. The Saudi government is represented either by PETROMIN, the state oil firm, or by SABIC, the Saudi Basic Industries Corporation. Each partner contributes 15% of the total capacity as equity, the Public Investment Fund (PIF) loans 60% at a nominal rate (ca. 2-4% p.a.), and the remaining 10% must be raised from international, commercial banking sources. Operating costs and output are shared pro rata, although marketing agreements exist in some cases whereby the foreign partner absorbs part of the Saudi share.

Diametrically opposite have been the strategies of Algeria, Kuwait, Libya and Iraq which, in spite of their divergent ideological positions, have all relied upon totally state-owned entities. While all must use foreign process licensors and foreign contractors, the capital and ownership of the ventures lie entirely in domestic, government hands. Kuwai had experimented originally with mixed-sector firms -- partly government-owned and partly local (national) stockholders, but the government of Kuwait ultimately bought out the private interests and reverted to total state ownership.

The current status of industrial ventures in Iran is somewhat obscure but it appears that the plants are essentially government-owned, along the lines of the Algerian or Libyan models. Some of the earliest petrochemical ventures had involved foreign partners, but this was not continued with the later complexes.

The policies in the other Arab states of the Gulf are more heterogeneous. Bahrain involved foreign partners in its aluminium smelter (ALBA), but the newest ventures -- the steel projects, the hydroprocessing cracking refinery, and the petrochemical plants -- involve the participation only of neighbouring Arab states from the Gulf Cooperation Council. Qatar and the UAE had assigned foreign partners minority interests in operations such as the LNG plant, the steel plant (QSC with Kobe Steel), and the aluminium smelter (DUBAL) but otherwise reserved any ventures strictly for their national enterprises.

3. Gas Pricing

There are also certain differences with regard to pricing gas. In most instances to date a purely notional price has been charged for the gas, hearkening back to the prior period when gas was flared and was a "free good" (see below). In Bahrain and Qatar, for example, the gas is transferred at a price of about 25 cents (US) per Mcf, without provision for surcharge.

There are two noteworthy exceptions, however. Kuwait has increasingly tried to charge a market price for gas, reflecting its scarcity value in terms of crude oil prices. This policy extends to the pricing of gas to power plants for domestic electricity. Saudi Arabia uses a different, less rigid device; it is reported to provide the gas at 50 cents (US) per Mcf -- corresponding to the very low valuation of $3 per barrel of oil equivalent (BOE). However, under the Saudi formula, there is a trigger once the venture achieves a threshold rate of return of some 15%, whereafter the gas price must be renegotiated in order to permit the state to capture the resource rent.

III. FACTOR ENDOWMENTS - FINANCIAL CAPITAL

An important advantage of the oil-exporting states of the Gulf is the relative abundance of capital. Some have surplus capital -- the low-absorbing states -- while others, the high-absorbers, do run current account deficits. The latter still enjoy unused borrowing capacity based upon their large oil earnings. In both cases both the opportunity costs and financial costs of capital are less than for most developing countries or industrial countries.

The opportunity cost of capital, and hence the target rates of return on industrial projects, is significantly lower for the oil-exporting states of the Gulf than for their competitors in the developing countries or the industrial states:

1. No taxes are included in revenue requirements.
2. The hurdle rate of return for projects has been linked to the real rate of return on portfolio investment in the West, i.e. circa 1-4% real.

The opportunity cost of capital for the major oil exporting states is different from that applicable to most of the developing countries, the NICs or in the industrialized states. The opportunity cost of capital must reflect their own special positions in international financial markets, either as borrowers or net lenders, and also must recognise their domestic fiscal regimes, in which both income and property taxes are often very much less than in the OECD states.

In particular, the high real rates of return used by major lending organisations, such as the World Bank (IBRD) for project evaluations are really not relevant for most of the oil-exporting states. Those discount rates are used by the IBRD as hurdle rates or screening rates to eliminate marginal, or relatively less attractive, projects in countries in which capital is scarce and where available funds must be directed towards the most remunerative projects. Since capital is scarce, only the best projects should be accepted, and a high opportunity cost, or rate of discount, is a screening device where ranking of projects is otherwise difficult.

In the oil-exporting countries the parameters are different, and projects have hitherto been more scarce than capital. Thus a better measure of the opportunity cost of capital is the rate at which they borrow or lend in financial markets, since capital is not the binding constraint in their industrial development programmes. We must, however, distinguish between two distinctly different types of oil-exporter:

- financial surplus states or "low absorbers"
- net borrowers or "high absorbers"

For both cases the interest rate, whether on net borrowings or on net placements of funds, is the real opportunity cost of capital, the difference between the two cases being the bankers' spread.

Case 1: "High Absorbers"

The "high absorbers" are countries such as Algeria, which is actively borrowing, or Libya, Qatar, and the UAE which have incurred deficits since oil markets stagnated after 1980/81 but which cover these deficits by drawing down upon financial reserves. More prominent examples, outside of the Gulf, are Nigeria, Mexico and Venezuela.

These OAPEC-member states have not reached any practical limits on their borrowing capacity, for the availability of capital to them seems to exceed the opportunities for investment in productive projects at home. The test of the opportunity cost is therefore the cost of additional debt, i.e. the real, inflation-corrected borrowing cost, and projects are indeed evaluated using the interest charges as the opportunity cost.

This borrowing cost is usually specified as a premium which they must pay over the LIBO (London Interbank Offer Rate)-based rate in the London or New York markets, which has not exceeded 1.5 to 2.5 percentage points in recent years. An upper bound for the opportunity cost of capital in these cases is roughly equal to, say, 200 basis points (2 percentage points) over the real interest cost for dollar loans in those two major financial markets (see below for estimate).

Case 2: "Low Absorbers"

For the capital-surplus oil-producing states, the opportunity cost of capital is the rate at which they can place funds. This is more complex, because these governments avail themselves of a wide spectrum of market opportunities, including not merely debt instruments but also equities, real estate, and direct investment.[2/]

However, with the sole known exception of Kuwait, most of the surplus funds are still invested in the money markets, albeit with a mix of maturities spanning the overnight market to long-term coporate and government bonds. A reasonable proxy for the cost of capital to this group are the 30-day and one-year rates in both the London and New York markets.

The real yield is that rate less the rate of inflation; for the latter we shall use the US wholesale price index. This is an appropriate metric because the price of oil is denominated in dollars, as are a significant fraction of the OPEC states' imports and financial transactions. The estimated real rates of return (ROR) in US markets since 1979 is displayed in Table 2.

Table 2 INDICATIVE FINANCIAL RATES OF RETURN (US)

	1979	1980	1981	1982
90-day rate	14.4	17.6	13.8	9.9
1-year rate	12.9	14.9	14.8	10.4
US WPI	12.6	14.0	9.1	2.1
Estimates Real ROR	0-2	1-4	5-6	8-10

Sources: Morgan Guaranty Trust, World Financial Markets; IMF International Financial Statistics for the US Wholesale Price Index (WPI)

The historical experience and that of the last three years (1982-1984) differ sharply. For the period between 1945 and 1980 real rates of return in US financial markets ranged between zero and about 4%, as averaged over periods of 3-5 years. Bonds and US Treasury bills scarcely yielded a positive rate of return, while the stock market over longer periods yielded about 4%.

Positive rates of return are a recent phenomenon, and there is no sign that the most current rates of 4-8% (real) are viewed as typical and thus that they influence investment decisions, and the opportunity costs of capital remain less in the Gulf than elsewhere.

State-owned enterprises are willing to accept lower yields on their equity capital, or as in the case of Saudi Arabia, highly subsidised finance is still available to industrial enterprises which otherwise meet the requirements for loans. Industrial ventures in Saudi Arabia can borrow from the Saudi Industrial Development Fund or the Public Investment Fund at nominal rates of 2-3% for at least one-half of the total capital requirement in spite of the fact that the Saudi Arabian Monetary Authority's short-term overseas investments may yield real rates of return of 6-8%.

For low-absorbing, capital-surplus countries the opportunity cost is still well below that desired in the West, given the absence of taxes or higher-cost equity capital. However, the 1.5-2 point premium now charged to the high-absorbing, capital-deficit states brings their cost of capital closer to that used in many developing countries and reduces their comparative advantage.

On balance, in spite of current deficits in some countries and in spite of retrenchment of general spending programmes, it still appears that industrial projects, if otherwise feasible, will continue to have high-priority claims on available funds, whether borrowed or internal, and that capital constraints will not affect the basic, energy-intensive industrial projects discussed here.

IV. FACTOR ENDOWMENT - AVAILABILITY AND EVALUATION OF GAS

Gas is the key factor in the future industrial development of the Gulf, and it is necessary to focus on both the constraints upon the supply of gas and the economic implications of competing cliams upon the use of that gas. Gas in the Gulf is still very cheap, but it is also valuable, all the more so because most is produced in conjunction with crude oil so that volumes today are increasingly limited.

The gas reserves are indeed large, as are the ratios of reserves to production in most countries, but these figures as such are quite misleading. In most of the OPEC states the gas reserves are associated gas, i.e. gas which can be produced only in conjunction with the oil, pari passu, so that exploitation of the gas is inextricably and almost proportionally tied to production of oil. Kuwait thus has 250 years' supply of gas, based upon current production rates, but nonetheless is short of disposable gas -- because oil output is low, directly limiting gas availability in spite of the very high reserve-to-production ratio (R/P) of 250-to-one.

The assessment of gas supplies in the Gulf must therefore look beyond the data on gas reserves and address directly three interrelated questions:

- what gas is available, i.e. differentiating between associated and non-associated gas?
- what is the value of gas used in different industries or markets?
- what are the competing claims for gas and how can these be ranked?

We therefore must examine the gas supply parameters to establish the bounds of gas availability and then enquire into the economic ranking of different gas-based projects. The derived or "netback" value of the gas in the sundry applications differ quite distinctly, as we shall see, and the hierarchical ranking of the energy-intensive projects must be based upon maximising the rents to be obtained from the gas itself.

A. Gas Supply

In most of the Middle East oil-exporting countries today gas is a scarce commodity and must be allocated to the most valuable uses. The supply/demand balance for gas in the Middle East has shifted significantly -- and possibly irreverisbly -- over the past decade. Gas had been a free good throughout the early history of the Middle East oil industry, and most of the first tranche of gas-based industries in the Middle East was predicated upon free gas, or at least upon gas priced only at the cost of gathering and delivery.

Until very recently, the notion that gas is a "free good" was not at all unreasonable. Massive amounts of gas were flared for lack of any economically viable means of commercialisation, and these conditions persisted until the end of the 1970s. Since then, however, the balance has changed for several reasons:

- Most gas in the Middle East is still produced as a co-product of oil output.
- Gas production rises or falls with the level of oil production and is thus intimately tied to international oil markets.
- The sharp drop in oil output since 1979/80 has led to a commensurate cut in production of associated gas.

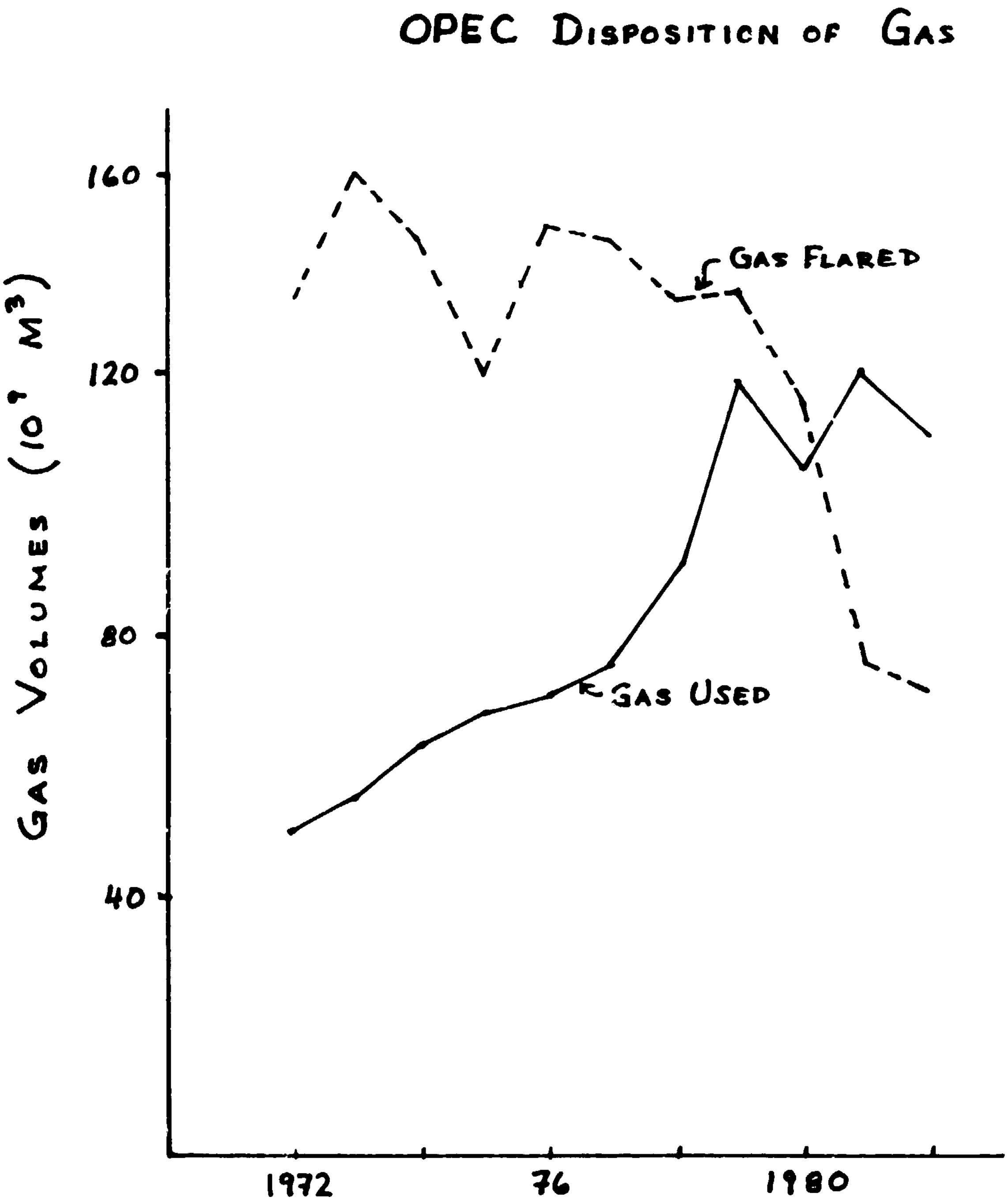
  Oil output in OPEC member states is about half its all-time peak, while production in Saudi Arabia and Kuwait is currently (1984) at a still lower level -- about 40% and 30% of the peaks, respectively.
- The rising oil wealth had triggered rapid growth in demand for both electricity and water.

  Gas needs for domestic consumption have risen more than proportionally. Electricity is generated using gas, and desalination plants based upon direct firing with gas, or upon heat extraction from gas-fueled power plants. provide much or all of the water for the states on the southern littoral of the Gulf.

The resulting squeeze is two-sided -- rising domestic demand presses closely against the falling production of associated gas -- and this has led to gas shortages in many areas. At present oil production levels -- ca. 18 mmb/d for OPEC as a whole -- there remains no significant marketable surplus of gas in the Gulf.

Figure One shows the precipitate drop in gas production in the OPEC states since 1979 and also the steady rise in gas consumed for industry or utilities. Use of gas has risen further since 1982, the last year for which comprehensive data are available, while production has fallen by at least one-third since then. Hence the margin between supply and demand has yet again narrowed. Moreover, even that assessment understates the supply gap because the newest tranche of industrial projects and power plants

FIGURE ONE


OPEC DISPOSITION OF GAS
GAS VOLUMES (10^9 M^3)
160
120
80
40
GAS FLARED
GAS USED
1972
76
1980

is only now beginning to come on stream. Domestic demand should increase still further, exacerbating the squeeze.

The quantities of flared gas -- the volume theoretically available for commercialisation -- remained roughly constant between 1970 and 1979, fluctuating between 120 and 140 milliard cubic metres p.a. (4-5 Tcf); this untapped energy source was indeed large -- the disposable gas was the equivalent of about 2 million barrels of oil per day or equal to one-third of total marketed US gas production (1980).

Local demand for gas within the OPEC states also grew apace during that same period, tripling between 1970 and 1980 from about 40 billion cubic metres (Bcm) to 120 Bcm per year. Gas is consumed largely for production of electricity or desalinating water, but industrial usage has become increasingly important in the last years. Also some gas was reinjected to sustain reservoir pressures as part of enhanced recovery schemes and thus is not available for commercial use.

Gas is now scarce, and the era of "free" gas is past. Indeed, gas will continue to be scarce in many of the oil-exporting states unless world oil demand picks up markedly or until accelerated exploration programmes for non-associated gas might bear fruit. The shortage does not affect all states, however, and it is necessary to distinguish between the future "have" and "have-not" states.

1. Potential Gas-Deficit States

Both Kuwait and Saudi Arabia illustrate the new circumstances of gas shortages: in the first case the spectre of shortage is real, while in the second it is imminent. Both have had to ration gas and to curtail industrial output at times since 1982, and both have intensified efforts to locate and develop non-associated gas fields which could be brough on stream as cushions against future fluctuations in oil output and associated gas volumes.

Kuwait is already "out of gas"; it relies entirely upon associated gas, and gas production is thus tied directly to oil output; under Kuwait's present OPEC oil production quota, 1.05 million b/d, associated gas output does not suffice to meet already established needs for gas for power, water, and the chemical plants. Already in 1982 (see Table 3) only 10% of total gas output was flared, and currently (1984) no gas which is economically recoverable is not fully exploited.

Indeed, ever since oil production began to be constrained after 1981/82, Kuwait has been increasingly obliged to burn fuel oil in the power plants and marketable light products in the refineries. In mid-1984 it announced that it must begin to import LPG since local gas production does not permit even that requirement to be covered, a further sign of the domestic gas deficit.

In the case of Saudi Arabia gas is still being flared, so that the gas deficit is imminent, as distinct from immediate. However, a gap emerges within a few years, by circa 1986/87, unless oil production once again rises significantly. Kown commitments for natural gas -- based upon power plants and factories now in operation or close to completion -- exceed by a wide margin the available associated gas, even when all of the presently flared gas is connected to the distribution grid (see further discussion in Section V).

2. Potential gas-surplus states.

Kuwait and Saudi Arabia epitomise the cases where gas is now scarce, but several countries have large known non-associated gas resources -- Algeria, Iran, and Qatar -- and for them industrial development is not constrained by gas availability. Of these non-associated gas deposits only those in Algeria are connected and being produced on a large scale at the present time. The reserves in these three countries are large and constitute the bulk of the reported gas reserves for OPEC in toto (Table 3).

Iran's non-associated gas reserves exceed 400 trillion cubic feet (Tcf), or alone are equal to about one-half of OPEC's total. Those of Algeria are greater than 120 Tcf, while Qatar's resources, if one includes the North Dome structure which is not yet officially reckoned with the reserves, are also well over 100 Tcf, although the official figure is still much more modest.

Table 3 GAS RESERVES AND PRODUCTION: MAJOR MIDDLE EAST OIL EXPORTERS (1982)

	Reserves (TCM)	Production (BCM/y)	Pro Forma (GOR)	Percent Flared
A. Potential "gas-surplus" states				
Algeria	3.2	82.1	(1)	6
Iran	13.7	24.5	1046	58
Qatar	1.8(2)	5.8	1733	8
B. Potential "gas deficit" states				
Iraq	0.8	4.2	423	84
Kuwait	1.0	4.6	570	10
Saudi Arabia	3.4	33.6	575	64
U.A.E.	0.8	13.5	1104	38

Source: OPEC, Annual Statistical Bulletin, 1982.

Notes: (1) the gas-oil ratio (GOR) is not meaningful for Algeria because most of the gas currently produced is non-associated and because of the condensate fields in which gas is recycled.

(2) Published reserves do not fully reflect the North Dome; reasonably assured reserves are at least 2-3 times higher.

TCM = trillion cubic metres

BCM = billion cubic metres

The costs of finding and producing non-associated gas are substantially higher than those for associated gas, where the costs are chargeable to the oil, the main product. These costs are nonetheless still very low by world standards and the valuable byproducts, LPG and NGL's, are expected to cover a large part of the production and processing costs of any large non-associated gas finds.

Non-associated gas is in fact essential to the longer-run operation of an industrial base, since otherwise the gas-fueled industries become hostage to the oil production level. Even if the industries run largely upon associated gas, it is necessary to have a certain cushion of non-associated gas capacity in ready reserve in order to ensure operating flexibility.

Given the necessity for some cushion, the available volumes of associated gas in the Middle East, i.e. those volumes of gas which are still being flared, provide a very limited basis for any further expansion of industry and must be reserved for power and water. Furthermore, even if oil output -- and thus associated gas production -- were to rise, some non-associated gas becomes almost a prerequisite since very high rates of utilisation of associated gas are impractical without recourse to some backup fuel source.

B. Valuation (Opportunity Cost) of Gas

The opportunity cost of gas in the Middle East is a derived quantity and depends upon a set of factors which are specific to each broad class of gas-using industry and, as well, to the circumstances of each plant.

We shall treat the value and opportunity cost of gas as being identical, but we note that the Algerian and Iranian governments argue that the "value" of gas at point of export (fob) should be equal to no less than the value or price of crude oil. This represents a logical political posture for a gas-rich exporter, but oil parity (fob) is a price which cannot be commanded on the market.

The gas value is the breakeven price for that gas charged to any venture for which the venture's gas-derived output is internationally competitive.

There is a broad spectrum of possible uses for gas in the Middle East; the major industrial routes for commercialising gas are displayed in Table 4. However, before gas can be allocated to industrial applications there are pre-emptive claims upon any available gas volumes in each exporting country -- domestic production of electricity and water desalination; these take first priority upon any supplies of gas.

Further, where gas might be needed for enhanced recovery or reservoir pressure maintenance projects, this, too, is a high priority use and also preempts gas from other industrial uses. Reservoir reinjection will be a critically important use of gas in Iran in the future, and will divert a large fraction of available gas, including both that from associated and non-associated production, for a sustained period of 15-25 years.

In Iran a massive programme was initiated in the mid-1970s, prior to the Revolution, to inject very large volumes of gas into Iran's oil reservoirs; the dual objectives were: 1) to reduce -- but not reverse -- the production decline rate; and 2) to increase overall recovery by about one-third. The requirements for gas for that project alone were equivalent to the entire volumes of associated gas, plus the dedication of an additional volume of non-associated gas of between 40 and 80 Tcf.

The remaining possible industrial uses of gas fall into three categories: first is the export of gas as energy -- converting it into methanol (methyl alcohol) or transforming it into LNG. A related application is to use the gas to fuel a refinery, an application which is increasingly attractive because petroleum refining is becoming every more energy-intensive, and the newest plants for producing a high-octane, lead-free gasoline or low-sulphur heavy fuel oil can consume 10-13% of total crude oil runs as process fuel.

The second category is the use of gas as a chemical feedstock. The manufacture of ammonia, which can be upgraded to urea, or of ethylene, the building block of the modern petrochemical industry, are the two most important applications. Both processes are conventional, and in both cases the gas-based plants in the Middle East would compete with the identical product manufactured using more expensive, oil-derived feedstocks in another area.

Table 4 ENERGY-INTENSIVE INDUSTRIES

Competing Energy Sources

I.	Energy Exports	
	Liquefied Natural Gas (LNG)	Heavy fuel oil/No.2
	Methanol	No.2/Gasoline pool
	Refining	Crude oil/natural gas
II.	Feedstock and Energy	
	Ethylene	US: ethane/LPG
		ROW: naphtha
	Fertilisers	
	Ammonia (NH3)	US: natural gas
		ROW: naphtha
	Urea	(from NH3)
	MBTE	Butane/methanol
III.	Energy	
	Aluminium	
	Refining	oil/coal
	Smelting	Hydoelectricity Coal/oil-fired electricity Nuclear energy
	Chlor-alkali	electricity
	Copper	
	Smelting	Coal/oil/gas
	Refining	Electricity
	Steel	
	Reduction	Metallurgical coal
	Mills	(electricity)

ROW: Rest of the World

The final category is the export of gas embedded as fuel in industrial processes, such as the direct reduction process (DR) for producing sponge iron. A second option is burning the gas to generate electricity and thence to produce aluminium ingot. Here the competitive status of gas is less unequivocal; gas as a reductant or as fuel for electricity generation competes only to a limited extent with oil. Here the competing fuels are metallurgical coal (steel) or oil, coal, hydro, or nuclear power (aluminium), depending upon the site of the competing facility.

The value of gas used in these various applications differs significantly; under current conditions, where gas is relatively scarce, only the highest valued applications warrant priority allocation of the available gas.

Gas values are derived on a netback basis, i.e. the values of the various products -- LNG, urea, or aluminium ingot -- are determined as the difference between the market value of the output of each process, less all the costs, except for gas. The residual, after deducting all costs of production, transportation, and marketing, is the value attributable to the gas, viz. the maximum price or rent which can be charged for the gas and leave the industry competitive.

Specifically, the steps in deriving the "netback value" of gas in the Middle East are:

1. For the competing product, determine the full costs of production, including capital, raw materials, and the full opportunity cost of fuels or feedstocks.
2. Deduct transportation costs from the Middle East to the test market, including shipping costs from source country to that market.
3. Determine the full costs of production in the Middle East, excluding any charge for the gas as fuel or feedstock, but including any extra charges related to the Middle East site, and also allowing for possibly lower opportunity costs of capital for Middle East host countries.
4. Establish the value of the gas charged to the plant as the difference between product value and product cost.
5. Determine the unit value of gas delivered to the plant as the residual value divided by the total gas supplied including plant losses or fuel.

This residual charge per unit of inlet gas is the value used for ranking gas projects.

This process can readily be illustrated for the use of gas which is viewed by Middle East planners as the least attractive -- LNG. This calculation thus provides a benchmark assessment for the minimum value of gas, which can then be used as a threshold test for the acceptability of other industrial projects.

The gas netback may be derived particularly easily for the case of liquefied natural gas (LNG) where it competes in the consuming country against low-sulphur heavy fuel oil for boiler fuel. This is the case both in Japan and most European markets where gas is burned on a significant scale for electricity generation and industrial steam-raising. In this case the cif value of gas delivered to the gas grid is equal to the ex refinery price of low-S No.6 HFO, plus or minus small adjustments for special quality factors and delivery charges.

The costs of marketing gas as LNG are twofold. First, there are the fixed costs, independent of distance to market, of liquefying the gas at point of export and the counterpart costs of regasifying it at point of delivery. As shown in Table 5 these amount to $1.23 and 55 cents per thousand cubic feet (Mcf) of gas delivered, respectively. A further element is the fuel required for the liquefaction plant which averages about 14% of the throughput, which is valued at the derived netback, i.e. total net realisations are divded by total gas supplied to the plant, including fuel.

The transportation cost in the cryogenic tankers depends almost proportionately upon distance except insofar as port turn-around times are determined only by loading and unloading rates and not by distance as such. For the case of a 12,000 km run to Tokyo from the Gulf the freight charge is $2.23/Mcf, including bunker costs and any boiloff LNG used as fuel.

The resulting gas value is very much less than crude oil parity, even though the LNG itself, once delivered to market, is a premium fuel. The netback ex liquefaction plant is the market value, taken as $5.00/Mcf, less the three charges, which aggregate to $4.01 per Mcf, leaving only $0.99 as the value of the gas itself. This residual value is recovered from a total of 1.14 Mcf of input gas per Mcf of output, so the wellhead value of the gas delivered into the LNG system comes to $0.85 (i.e. $0.99 divided by 1.14).

The pricing of natural gas in areas which cannot economically be connected by pipeline to major consumption centres exhibits several distinctive features[5/], which derive from the high conversion or transportation costs, as illustrated in the preceding netback calculation for the use of LNG. While it is beyond the scope of this study to compute the hierarchical rankings of gas for the various industries listed in Table 5, we can observe several general precepts:

- values depend strongly upon the use of the gas.
- for any given commercialisation route the derived gas value depends strongly upon the particularly sub-market which is open.
- since the highest value markets are finite, lower value options must also be considered, i.e. it is improbable that any country could specialise in commercialising its gas in only one form.

The "price" for natural gas thus cannot be stipulated uniquely; instead it depends upon a number of considerations specific to each industrial venture in each location and for each market destination:

- The "price" of natural gas charged to an industrial project is a free parameter, which can be set at whatever level is needed to ensure profitability.
- Gas is no longer a "free good", and a positive value is demanded for projects.
- The opportunity cost is tested against a set of possible projects, and the netback value attributable to the gas becomes an important part of the selection criterion.
- While a gas price below crude parity is acceptable, no government thus far has been willing to price crude oil significantly below current market prices.
- Alternative concepts for valuing gas have been advanced but are not generally accepted:
  - -- Absolute export parity with crude oil (Algeria)
  - -- The present discounted value of its commercialisable price in the distant future, which is equivalent in most cases to a current "price" much less than crude oil.

    This concept has been proposed by the IBRD in analysing gas-based industrial projects outside of the OPEC states[6/].

Table 5 GAS VALUATION: LIQUEFIED NATURAL GAS (LNG)

LNG VALUE (CIF)		$5.00
Regasification Costs	- 0.55	
Transport Costs		
a. 12,000 kms	- 2.23	
b. 3,000 kms	- 0.5[illegible]	
Liquefaction Costs	- 1.23	
NETBACK VALUE (per Mcf delivered)		
a. 12,000 kms	+ 0.99	
b. 3,000 kms	+ 2.65	
Plant Losses: 14% of input		
PLANT INLET GAS VALUE		
a. 12,000 kms	+ 0.85	
b. 3,000 kms	+ 2.28	

Source: T. Stauffer

Since 1979/80 gas netbacks in the Middle East have been positive for all listed industrial projects, a difference compared with the situation in the mid-1970s, prior to the last oil price increase which dragged gas values upwards.

Even though there is uncertainty how to price the gas, the absolute advantage of Middle East producers is clear, and the determinant of industrial expansion is not "cost" but rather the choice of industries and — in most countries — the likely availability of gas, since for most exporters associated gas, once a free good, is now in tight supply.

As a final note it is important to stress that Middle East governments, irrespective of the size of their oil reserves, have been reluctant to use "economic" pricing for crude oil. Strictly speaking the present value today of a barrel of crude oil produced 100-150 years in the future is likely to be very low — at any discount rate deemed reasonable. Hence it can be argued that the opportunity cost of using oil for industrial fuel is also very low -- since the extra barrel burned today might not otherwise be produced for many years in the future.

This argument is rejected by producing governments, which tend consistently to value crude oil at its current market price less only the discount needed to sustain sales, which leads to values which are much higher than the "economic" calculation. In the case of Kuwait, for example, the current R/P ratio, based upon proven and known reserves, is close to 200 -- so that the "economic" cost of a barrel of Kuwait crude oil for industry is the present value of a barrel of oil 200 years from now. Even if discounted at a mere 1% the value is only about $4 or some 65 cents/Mcf, much less than market parity. At higher discount rates the "economic" opportunity cost drops dramatically.

Implicit in the valuation of the governments is a Hotelling-like model for oil pricing -- i.e. they value future production, however remote, at today's price, which is equivalent to presuming that the oil price shall rise exponentially at the real rate of interest. This presumption was indeed made explicit at one point by the OPEC Long-Term Strategy Committee and remains residually and implicitly as part of the policy which does not discount future crude oil production.

Whatever may be the underlying logic, the fact remains that oil is valued at current prices and thus is not discounted as either industrial fuel or industrial feedstock, so that oil-based industries, other than refineries, are not part of the industrial strategy in the Gulf states or elsewhere among the OPEC members.

V. PRIORITIES FOR GAS-BASED INDUSTRY

A. Introduction

As indicated earlier, energy-intensive industry in the Middle East today enjoys an absolute advantage versus most other sites in the world, especially for those industries where competitors outside of the Middle East must rely upon natural gas (fertiliser) or upon costly petroleum derivatives.

We have listed in Table Four the candidate industries for the Middle East where all are both energy and capital-intensive, matching the factor endowments of the oil-exporting states of the Middle East. In all cases, if gas as fuel or feedstock is priced at cost, new "greenfield" plants in the Middle East can undercut new plants located elsewhere which are forced to pay market prices for oil or oil-parity prices for gas. They can compete favourably against older, largely depreciated "redfield" plants whose fuel or feedstock prices are tied to oil.

While the absolute advantage of energy-intensive industry in the oil-exporting states is clear, the relative advantages of the different industries and the priorities for claims on gas are less clear. The key issues affecting future industrialization in the Middle East are twofold:

- First, is there enough gas to satisfy domestic needs for electricity and water and still leave undedicated supply for industry?
- Second, if gas is available, which industries yield the highest national return, net of the opportunity cost of capital and all input costs?

The first addresses the issue of whether industrial development is constrained by lack of gas, either associated or non-associated, while the second focuses on the priority ranking of the wide spectrum of industrial options.

The preference criterion for ranking industries, given a gas constraint, is the economic rent per unit of gas, i.e. the value-added attributed to the gas itself, net of factor payments, and we shall sketch here the considerations that enter into that ranking, as well as indicating the severity of the gas shortage which delimits the future scope of industrialization in a number of the exporters.

B. Competing Claims for Gas

The various industrial uses of gas compete directly with domestic requirements under today's conditions where gas is all but completely deducated to existing or pending plants in most oil-exporting countries of the area. In order to measure the scope for future industrialization it is useful to compare the gas requirements of a "standard-scale" plant of each of the major types against available gas supply.

A quick test of the scope for industrialization in those countries which rely upon associated gas is to determine how many barrels of oil must be dedicated to support a given plant, in terms of the gas derived from that level of oil production. This will depend upon the gas requirements for a standard-size plant in each industry and also upon the amount of gas co-produced with the oil.

The gas-oil ratio (GOR) varies from field to field in the Middle East, and also it can change no less widely over the lifetime of any given field. Oil production yields between as little as 300 and as much as 1800-plus cubic feet of wet gas per barrel of oil, although for the major oil fields in the region the range is rather narrower, and an average GOR of 500 is indeed representative (see Table 3).

The major uses of gas are listed in Table 6, where for each industry is shown:

Table 6 DEDICATED GAS VOLUMES

		Plant Size	Load Factor	Dedicated Reserves	Oil Equiv. Volumes
I.	Energy Exports				
	LNG	250MMcf/d	0.85	1.8	600,000
	Methanol	2000T/d	0.85	0.6	150,000
	Refining	250 Mb/d	0.90	1.5	500,000
II.	Feedstock and Energy				
	Ethylene	500,000T/y	0.90	0.8	140,000
	Ammonia (NH3)	1500T/d	0.85	0.4	100,000
III.	Embedded Energy				
	Al Smelting	150MT/y	0.9	0.7	125,000
	DRI	800MT/y	0.9	0.4	70,000
IV.	Electricity				
	Steam Plants	1 GWe	0.7	1.8	500,000
	Gas Turbines	1 GWe	0.90	2.2	700,000

Source: Stauffer, IIASA/RFF Paper, 1984

Notes: "Dedicated Reserves" are the volumes of gas required to fuel the facility over its expected economic lifetime.

"Oil-Equivalent Volumes" denote the oil production level required to fuel the given facility at a representative gas-oil ratio (COR) of 500 cubic ft. per barrel of oil.

Electricity: heat rate for steam plants 10,000 BTU/Kwhr; for gas turbines 14,000 BTU/Kwhr. Plant lifetimes: steam 30 years, gas turbines 20 years.

Refinery: total fuel externally supplied; refinergy gases assumed to be recovered and marketed.

Ethylene: based upon methane-equivalents.

1) the standard size of the "world-scale", competitive plant;
2) the annual capacity factor;
3) the volume of gas which must be dedicated to the plant over its expected lifetime;
4) the level of daily oil production needed to provide the plant with enough fuel if the GOR is assumed to be 500.

Overwhelmingly important is the volume of gas required for electricity — each 1000 megawatts of power requires at full load the associated gas from at least 500,000 barrels per day of oil production. If the GOR is higher, as in Qatar, for example, commensurately smaller volumes of oil production would need to be dedicated to the power plant. Thus, if the GOR were, say, 1000 cubic feet/barrel (which is rare in large fields), the requirement is still 250,000 b/d.

If electricity is generated with the less efficient gas turbines or diesel engines the requisite dedicated oil production level is even larger -- some 700,000 b/d per 1000 megawatts of generating capacity. Both kinds of station are still common in the Middle East, partly because of their particularly low capital cost and partly because they are modular and can be constructed much more quickly than the thermodynamically more efficient steam turbine plants.

Electricity demands are sizeable and now preempt a large and growing fraction of total available gas in the Gulf. Saudi Arabia, for example, anticipates at least 10,000 megawatts of installed power generating capacity by the late 1980s, and Kuwait about 4,000. The electricity requirement alone will quite exhaust their associated gas supplies at peak load, based upon production levels of circa 5 MMb/d and 1.1 MMb/d, respectively.

Indeed, Kuwait's associated gas is already fully committed -- at current production levels of 800,000 b/d (May, 1984) -- liquid fuels are needed to supplement the last increments of associated gas.

The Saudi requirements for natural gas for electricity and large industrial use accumulate to 3.4 million Mcf (91 billion cubic metres) per year once current industrial and power projects now under way are completed (see Table 7). This quite concrete requirement is in fact a lower bound,

Table 7 GAS DEMAND IN SAUDI ARABIA: INDUSTRY AND POWER (mid 1980s)

		Installed Capacity	Gas Requirements	Equivalent Oil Production
A.	Electricity	15.6MWe	2500 kMcf/d	4.3 mmb/d
B.	Industry	—	900	1.6
	Refining	1.2 mmb/d	366	0.6
	Ethylene	1.6 mmT/y	230	0.4
	Methanol	1.3 mmT/y	150	0.3
	Fertiliser	1.0 mmT/y	110	0.2
	Steel	0.9 mmT/y	40	0.1
C.	TOTAL		3400	5.9 mmb/d

Sources: Industries: Royal Commission for Jubail and Yanbu, Annual Report 1982.

Consumption: Table 6 (infra)

Notes:
(1) All figures rounded
(2) Electricity production: one-half gas turbine, one-half steam turbine; load factor = 0.55
(3) No allowance for water desalination energy requirement.
(4) Gas-oil ratio (GOR) = 575 cf/b (1982)
(5) Ethylene: volume computed as methane equivalent (see text).

since it does not include the additional gas needed for water desalination, gas plant fuel, or small industry. Seventy per cent of this minimum total requirement is for electricity, with the remainder for the array of industrial schemes.[7]

That volume of gas, excluding the requirements for water, would require a minimum oil production level of 5.9 mmb/d, which is above the residual production quota alloted to Saudi Arabia under the current OPEC agreement. Known needs thus already exceed currently established production.

Indeed, the required production level would in practice need to be substantially higher to allow for operating fluctuations. Since electricity demand and oil production are seasonal and apposed — water and electricity requirements are highest in the summer when production traditionally has been lowest. Present schemes may in fact require an even higher annual average production level of at least some 8 mmb/d, in order to provide a cushion for seasonal effects, some safety and turndown margin, fuel for the gas processing plants, and some unavoidable losses.

Water production, in those countries requiring desalination, further adds to domestic, non-industrial energy needs. No survey of fuel requirements for desalination facilities has been located; however, in most instances the water plants are coupled to power plants and fueled by "waste heat", so that the maximum additional fuel required for water desalination can be related to total fuel requirement for electricity generation.

Desalination plants add directly or indirectly to the total energy inputs for the production of electricity, even where the exhaust heat is used, because back-pressuring turbines, or exhausting steam, does require additional heat input in a steam turbine plant because the turbine is less efficient in such an operating mode.

Very roughly one can estimate that water needs will add some 20% or more to the energy for electricity, under operating conditions where the waste heat is fully utilised, based upon a rough overview of prevailing water/power ratios. Even where exhaust heat from combustion gas turbines is recovered for desalination plants, one has foregone the additional electricity from using a combined-cycle plant, so that even in the case the energy opportunity cost is in the range of 40-plus per cent of the full-load input energy.

Joint domestic needs for electricity and water thus are already the major demand for gas. In Saudi Arabia, for example, one can estimate that one-half of all gas, even at prior historic peak production levels of 10-11 mmb/d, would have been needed to furnish already scheduled domestic needs for water and electricity. At current production levels, the balance is more precarious, and we have shown above that a lower bound for estimated gas needs already exceeds scheduled production within 3-4 years.

Other industries also consume large volumes of gas. Refineries and LNG plants require particularly large volumes of dedicated production as well — in each case the "standard" facility consumes roughly the same quantities of gas as a 1000 megawatt power plant, so that such facilities, too, commit significant fractions of the associated gas available at current oil production levels. The Saudi refineries and ethylene plants together will consume gas equivalent to one-fifth of oil production under the 1984 "quota" alloted to Saudi Arabia.

The other plants require more modest volumes of gas, ranging from 70,000 b/d of oil production-equivalent for a 800,000 ton/year direct reduction plant to some 125,000 b/d for an aluminium smelter of 150,000 tons/year. These volumes, however, loom larger when electricity and water needs command a large fraction of available gas, so that the margin left for industry is narrower.

On balance the scope for large new industry in the Gulf is limited presently by the overall availability of associated gas. However several factors affect the gas constraint, and it is possible that this may prove to be temporary if certain conditions are realised:

1. If global demand for Middle East oil rises, the available gas rises disproportionately, and the constraint would no longer be binding.

   However, given the need for a cushion against production fluctuations a considerable increase would be needed in both Kuwait and Saudi Arabia.

2. Significant discoveries of non-associated gas would provide the needed flexibility.

   While dry gas is more costly to produce, its cost is still very low in relation to its commercialisable value, and the feasibility of the industries is not seriously affected.

3. Nuclear plants could relive the demand for gas for power generation, a strategy proposed both by Iran and Egypt and now being discussed by Iraq as well.

Moreover, we observe again that a small subset of the exporters already have large reserves of non-associated gas, and three countries, in particular, are in better positions:

- Algeria's reserves are more than ample for a major expansion of gas-intensive industry.
- Iran's reserves are even larger, but large volumes also are needed for the long-term reservoir reinjection programme.

  This would require most or all of the currently produced associated gas, as well as a sizeable fraction of the non-associated reserves.
- Qatar's reserves are large enough to supplement foreseeable needs in the Arab Gulf states, as well as any imaginable needs of its own.

  A pipeline grid to connect Qatar with Kuwait, Saudi Arabia and Bahrain is now being discussed by the Gulf Co-operation Council.

  Transmission costs, plus the wellhead price likely to be required by Qatar, considerably reduce the attractiveness of any ventures located outside of Qatar, so this option, while technically feasible, offers little economic incentive to other partners unless the gas rents are split through some innovative formula.

The prospects for further industrialization in the Gulf, and thus perforce the prospects for related South-South co-operation, hinge first and foremost upon how the now scarce supply of undedicated gas can either be expanded or most efficiently allocated.

C. Industry Priorities

It is beyond the scope of this review to calculate the gas netbacks associated with each industrial option, but there is indicative evidence which suggests the relative rankings in terms of the derived wellhead value of the gas which can be realised in each of the cases.

A key element in commercialising gas is the relative cost of conversion of the gas embedded in the product, which includes both differential processing costs and transportation differentials — this can be compared across products and also with the competing sources of the product. One simple test is the cost of transporting gas to market in different forms, whereby we interpret each of the processes from Table 8 as a means of commercialising or marketing natural gas without building a pipeline, i.e. by convering the gas into a form more amenable to shipment. For all cases, the shipping cost is a measure of the relative penalty for commercialising gas in that form.

In Table 8 are shown the volumes of gas which are embedded in each of the major export options, together with illustrative transportation costs for the final products from the Gulf to Japan or an East Asian customer. The shipping costs cluster in three categories. The lowest cost per embedded Mcf is found for the manufacture of aluminium ingot or methanol. For both products the gas transport costs are less than 50 US cents per contained 1000 cubic feet of gas.

The highest transportation cost is for the case where the gas is marketed directly as energy in the form of LNG, rather than as an industrial product. This cost depends very strongly upon distance, but for an LNG between the Gulf and Japan, the nearest industrialized customer, the transportation cost is some $3-plus per Mcf. This cost includes the regasification and liquefaction charges as well.

The other gas-intensive products imply shipping costs between one and two dollars per unit of contained gas; these are less precise, in part because these goods in part would be shipped in smaller lots and at spot rates. Sponge iron and ammonia are parcel trades, since the monthly output of typical plants could not fill standard vessels.

However, the transport penalty could be less under certain conditions for the case of urea, sponge iron and steel products. In those cases, Middle East exporters could enjoy an additional freight advantage from "backhaul" trades, since outgoing freight rates tend to be lower. This arises because the region exports little general cargo compared to that moving inwards.

Table 8 ENERGY-INTENSIVE INDUSTRIES:

Key Parameters

	Gas/Tonne (Mcf)	Shipping ($/ton)(3)	Shipping ($/Mcf)
I. Energy Exports			
Liquefied Natural Gas (LNG)	--	--	3.25(1)
Methanol	32	8-12	0.25-38
Refining	5	6-8	1.20-1.60(4)
II. Feedstock and Energy			
Ethylene	65	50-80	0.90-1.20
Ammonia (NH3)	38	40	1.00
III. Energy			
Aluminium (2)	180	40	0.25
Sponge Iron (DRI)	14	20	1.43

Notes: (1) LNG: transportation cost includes costs of liquefaction and regasification.

(2) Aluminium: based upon integrated smelter which manufactures own anodes; does not include refining of alumina, which is presumed to imported.

(3) Shipping costs: reference trade is the Gulf to Japan.

(4) Total shipping cost for refined products; not differential cost vs. crude oil; see text.

Outbound ships are either unladen or underladen, so that the competition for cargo is intense and rates accordingly are much more favourable, a condition which is expected to prevail for the foreseeable future.

The range of shipping costs suggests that the netbacks do differ strongly across industries, which is supported by project studies which include, as well, not only differential shipping costs but also differential conversion and processing costs between the Gulf and competing locations. Representative values of the gas netback (residual producers' rent) for a cross-section of industries are shown in Table 9, which illustrates the wide range -- ten-to-one -- of relative gas values.[8/]

Refining yields the highest netback gas value -- between three and six dollars per Mcf, depending upon configuration; the more intensive is the processing, the greater is both the energy and capital intensity of the plant and hence the greater is the relative advantage of the Gulf producers.

The case of methanol illustrates the differentiation across markets; chemical-grade methanol proves to be a valuable outlet for gas, while fuel-grade methanol is quite unremunerative. For chemical methanol, where a Gulf manufacturer competes against methanol produced elsewhere from light petroleum products, the advantage is very large, and the gas value is over $5/Mcf. This results partly from the capital cost advantage and partly from the relatively low costs of shipping methanol, which can be transported at a small premium in conventional product tankers.

The gas value is scarcely one-tenth as high -- about 50 cents versus ca. $5 -- if methanol is produced for motor fuel, where it competes not against methanol but against crude oil into a refinery. In that sub-market the value of methanol is closely related to the value for high-octane gasoline blending stocks, and, even allowing for its high RON blending numbers, the high costs of manufacturing methanol cut deeply into the value of the input gas.[10/]

LNG illustrates the impact of geographical differentiation of markets, since the costs of shipping LNG in cryogenic tankers are so high that the netback value proves to be extremely sensitive to distance. For a short-haul LNG trade, such as across the Mediterranean, the shipping costs are less

Table 9 HIERARCHY OF GAS VALUATIONS

Industry	Netback Value
Hydrocracking Refinery	$3-6.00
Methanol - Chemical	5.50
LNG - (3000 Km route)	3.75
Aluminium (Nuclear/Coal)	3.50
LNG - (12,000 Km route)	1.25
Aluminium (Hydro)	ca. 1.00
Methanol - Motor Fuel	ca. 0.50

Source: T. R. Stauffer, IIASA Paper, op. cit.[9/]

than $1.00/Mcf and the netback value, after deducting all processing and shipping charges, is $3.50-4.00 per Mcf. However for a longer trade, such as the 12,000 km run from the Gulf to the United States, the netback is only about $1.25, very much less.

More generally, under post-1980 market conditions, even with the recent fall in real oil prices, all such industrial ventures are potentially feasible in the sense that they yield a positive netback value for gas. Moreover, even though some markets, such as chemical-grade methanol, offer particularly high netbacks, the highest-value options are limited, and lower-value uses must be considered.

VI. COMPLEMENTARITIES AND CONFLICTS

Industrialization in the Gulf creates some complementarities vis-a-vis the rest of Third World but also creates new intra-Third World competition, so that a ready balance of benefits and burdens cannot be drawn. Some of the heavy industry in the area preempts growth in those sectors in the industrial states or competes directly with existing under-utilised capacity, but some of the new capacity in the Gulf also displaces exports from certain of the NICs as well.

We outline below the areas when industrial ventures in the oil-exporting states offer opportunities for "South-South" co-operation and also note where new industrial ventures in the oil-exporting states compete directly with industrial projects in other states of the "South", including those which may benefit from the construction projects for the very plants which later challenge their own.

A. Complementary Facets

The first and most obvious complementarity lies in the opportunity for contractors from other "Southern" countries to participate in the construction of new industrial projects or for their engineering industries to supply equipment. The other principal complementarity involves two forms of backwards integration -- opportunities for the states of the Gulf to invest in the developing countries to obtain the raw materials for their new industries and the possibilities for the NICs to integrate backwards into joint ventures in the Gulf for production of basic chemicals or intermediate products for their own domestic industries.

Industrial and infrastructural projects in the Gulf do offer real opportunity for the contractors and construction firms from the South. Since these plants are primarily to be built in the Gulf, it is expected that Asian contractors, in particular, will be heavily involved in these projects, reflecting their already important role in the region. This represents added business in the sense that such plants replace comparable facilities in the OECD states, where Asian labour or firms would have little entry, and new ventures of this sort in the Middle East are truly incremental.

While it is reasonable to expect that Asian firms, in particular, might capture a sizeable share of these contracts, it must also be noted that the input would largely cease once construction has been completed. Labour requirements for such projects -- all being eminently capital-intensive -- are comparatively small and, moreover, the needed skill levels tend to be quite high. Follow-on sales are likely to be small.

A second area of complementarity is the possible supply of raw materials for the energy-intensive industries. The major industries are displayed in Table 10, together with their most important raw materials other than energy. The inputs are arrayed along with the developing countries which are potential sources of supply.

These opportunities are surprisingly limited, and the only two large inputs are bauxite for the aluminium smelters and iron ore for the DRI plants. Bauxite can be supplied by a range of countries from the "South" -- from Guinea to Brazil or India, but the most aggressively competitive exporter of bauxite -- and now the major source for the Middle East -- is Australia, which, while a major exporter of raw materials, ranks with the industrial states of the "North".

Backward integration by oil-exporting states into the supply of industrial raw materials from developing countries has in fact already begun on a small but

Table 10 **PRINCIPAL RAW MATERIALS**

Industry	Raw Material	Developing Countries Sources
Aluminium	Bauxite	Guinea, Jamaica, Surinam, Brazil, Guyana, India, China, Dominican Republic
Chlor-alkali	Salt	India, Brazil, Turkey, Benin, Bahamas, Pakistan, Argentina
Copper	Cu Ores (various)	Chile, Zambia, Zaire, Peru, Philippines, Papua New Guinea
Fertilisers	Phosphates	Morocco, Jordan, Togo, Brazil, Nauru, Christmas Island, Senegal
Steel	Iron Ore	Brazil, India, Liberia, Mauritania, Chile, Peru, North Korea

Notes:

1. Source: U.S. Bureau of Mines, Minerals Yearbook
2. Production in oil-exporting developing countries excluded
3. Sources listed in descending order of total production

systematic scale. Kuwait, starting in the early 1970s, evolved a major financial interest in the iron mines of Mauritania, which, however, thus far is only a theoretical form of backward integration since its own steel project has been shelved and the Mauritanian ores are marketed elsewhere.[11/]

One noteworthy venture is the bilateral arrangement between Indian and Iran, involving countertrades in iron ore and crude oil, a model which may be repeated in the future. Indian iron ore is supplied to the steel works in Isfahan under a long-term contract, while Iranian crude oil is shipped to India's Madras refinery, in which NIOC holds an equity interest.

Active co-operation has also emerged in the manufacture of compound fertilisers. Kuwait has taken the lead in this sector, and phosphates from Jordan and Tunisia are being processed with ammonia, principally from Kuwait, to produce compound fertilisers. Intra-regional, intra-South joint manufacturing activity in this quite specialised sector is expected to expand, commensurate with plans for expansion of phosphate production in Morocco, Tunisia, Egypt, and Jordan. It naturally is limied to those few developing countries with exportable phosphate deposits.

Kuwait also participates in two interconnected fertiliser ventures in Tunisia: l'Industrie Chemique Maghrevienne and the Societe Engrais de Gabes, which produce diammonium phosphate and phosphoric acid. The complementarity between Kuwait's gas-derived nitrogen supplies and Tunisia's phosphate deposits is particularly clear. Provision has been made for future extraction of uranium from the phosphoric acid plant, since the Tunisian deposits contain some 100-plus parts per million of recoverable uranium.

Kuwait and several other Arab oil producers are also involved in integrated manufacture of fertilisers in Jordan via three ventures: the Arab Potash Company, the Jordan Phosphate Mining Co. Ltd., and Jordan Fertiliser Industries, which supply the potassium (potash) and phosphate for processing with Kuwait's gas-derived nitrogen (ammonia).

However, Australia remains as an important and effective competitor to developing countries' exporters of both bauxite and iron ore; its deposits are large, high-grade, and the industry is efficiently organised. Moreover, the distances are comparatively short, compared with African or Latin American sources, and this advantage could be enhanced by the use of OBO carriers.

There are also a few isolated examples where NICs have undertaken joint industrial ventures in the oil-exporting states. Taiwan Fertiliser Company has a partial interest in one of the ammonia/urea complexes at Jubail, as a partner with SABIC, and the Chinese company's share of the output will replace very high-cost ammonia produced on Taiwan from naphtha. Similarly, a Korean conglomerate, the Lucky group, has announced its participation with SABIC in polyvinyl chloride (PVC) plant to be constructed in Jubail using local ethylene.

Both of the latter two cases represent a form of "adaptive complementarity", since the two projects are in effect substituting for related plants located in Taiwan or Korea, respectively, which would have used the much more expensive liquid-derived fuels or feedstocks. Both ventures displace domestic capacity but do provide for participation.

B. Intra-south Competition

The possibilities for South-South competition are real, and industrial ventures in the Gulf compete directly with analogous industries located elsewhere in the South. Many of the key industries targeted by the OPEC states are identical to those which rank high in the industrial priorities of many developing countries or NICs -- steel, fertilisers, refining and petrochemicals are the most prominent examples.

In this respect the industrial aspirations of the oil-exporting states parallel those of the other aspiring non-industrial states of newly-industrialised states, so that the scope for competition between oil-exporters and NICs is indeed fundamental.

Thus, across the board, all gas-based Middle East industrial projects -- except for the exportation of developing countries -- will compete against plants located either in the South or the North, directly or indirectly. The competition is likely to be particularly direct with regard to refined products, petrochemicals, steel, and fertilisers, where markets are especially fragile due to large overcapacity at the present time and where the cost advantage which the associated gas gives to Middle East producers is quite large in relation to prevailing profit margins.

More generally, this competition will arise in three different classes of markets:

- Import substitution.

  Local production in the Middle East serves first to substitute for imports. This backing out of imports from both NICs and industrial states has already been observed in the case of aluminium ingot, steel construction materials, and basic petro-chemical intermediates.

  The process is especially successful in the case of cement, in which the Gulf today is largely self-sufficient, eliminating a once lucrative export market for both European and Asian producers.

  Local Middle East manufacturers compete here most directly with the NICs, because both concentrate upon the more basic products with lower value-added, such as rebars.

- Home markets (NICs/developing countries)

  Middle East exports can compete actively in the home markets of other countries of the South in those areas where the comparative advantage of the Middle East is greatest, i.e. those products manufactured elsewhere using petroleum or gas as feedstocks or where electricity costs are tied to oil.

  Methanol, PVC, ethylene, refined products, and aluminium from the Middle East enjoy both an absolute and also a comparative advantage and can be priced to compete favourably in most markets.

  The transportation advantage enjoyed by the home market in these cases, as discussed earlier, is relatively small in comparison with the cost advantage enjoyed by producers of "cheap" gas. Fertiliser production is particularly exposed.

- Third-country markets

  These are smaller, but here, too, Middle East exporters of aluminium and fertilisers, especially, will actively compete with plants from other developing countries or NICs.

  In these markets even the limited transportation advantage of the non-Middle Eastern producers is reduced, since both must incur transportation costs. The opportunity for Middle East

> exporters to obtain "backhaul" shipping rates is important in this context and adds to their comparative advantage.
>
> Over the medium-term, however, the Middle East is not likely to export more processed products, since output there may not suffice for internal consumption, or would be most probably consumed at least within the region. The new aluminium rolling mill in Bahrain, for example, will principally reduce imports to the whole Gulf area.

To some extent there is, at least in principle, also scope for South-South co-operation in some of these areas. Where the comparative advantage derived from Middle East gas is highest, new capacity destined for South markets can be constructed as joint ventures between NIC firms, especially, and local national oil or industrial companies.

One such joint venture is the fertiliser plant at Jubail jointly undertaken by a Taiwanese firm and the Saudi Basic Industries Corporation (SABIC), but it is doubtful if many more will emerge, partly due to the fact that foreign participation, whether by developed-country MNC's or firms from the NICs, is rather rare and, indeed, is standard practice only in Saudi Arabia.

Consequently, one can conclude the following:

- Limited South-South complementarity exists in terms of raw material supplies, principally iron ore and bauxite.
- Considerable short-term complementarity exists in terms of opportunities for NICs or developing countries construction firms for erection and equipment contracts.
- Significant competition between the oil-exporters and other developing countries is emerging in terms of steel products, fertilisers, refined products and petrochemical intermediates.
- This competition appears in all markets, third-party as well as each party's domestic markets.

FOOTNOTES

1. The literature on industrialization in the Gulf is scattered and usually focuses on specific cases of single plants, the feasibility which is tested against other related plants constructed elsewhere.

   Turner and Bedore provided a non-analytical overview of the institutional questions, while Stauffer (1975) and GOIC/UNIDO presented more comprehensive evaluations of economic feasibility. The Stauffer study derived gas values from structural costs in competing markets, while the GOIC/UNIDO studies assumed specific gas prices in the Gulf.

   Most of the detailed studies of individual industries or plants were prepared for potential investors and are proprietary.

2. al-Zamil; op. cit.; MEES, 8 February 1982.

3. See Bank of England, Quarterly Bulletin, various issues.

4. See Stauffer (1984-IIASA/RFF paper); G. Bonfiglioli.

5. For equal volumes of energy it is more costly to transport gas, given its lower density versus crude oil; hence the export value of gas usually is less than that of crude oil, in spite of the superior technical characteristics of gas as fuel.

6. See G. Schramm.

7. There are additional fuel requirements for the ethane and LPG extraction plants. Depending upon the richness of the gas stream and the depth of extraction realised, plant fuel can consume as much as 15% of total gas throughput. This is over and above the fuel needs for water programmes to be discussed later.

8. Stauffer (1984 - IIASA/RFF paper); J. F. Rischard.

9. The gas valuations have been derived from a mix of published sources and unpublished consultants' studies; see Stauffer (1984) and GOIC/UNIDO.

10. J. F. Richard, op. cit.

11. F. Grosrichard provided an accessible survey of that facility in le Monde, 24 July 1984.

BIBLIOGRAPHY

Aluminium Bahrain B.S.C., "Aluminium Bahrain: Pacesetter of the Gulf's New Industrial Age", Manama, n.d.

......., "Ten Years of Aluminium smelting in Bahrain", Manama, n.d.

al-Zamil, Abdulaziz, Interview: Middle East Economic Survey, 8 February 1982 (Supplement).

ARBAL 1., First International Arab Aluminium Conference, Kuwait Aluminium Co., K.S.C., Kuwait, Oct. 1983.

Balasz, E.T. and Balkay, B. (UNIDO), "The Present and Future of the Aluminium Industry in the Arab World and UNIDO's Role in its Development", in ARBAL 1(q.v.), pp.56-101.

Berman, I.M., "Cogeneration, combined cycles, and synthetic fuels: an overview", Power Engineering, No.v 1983, pp.42-50.

bin Dasman, Khalifa and Roberts, M.J., "'DUBAL' - the Smelter with a Difference", in ARBAL 1 (q.v.), pp.102-23.

Bjerkholt, O.; Longva, S.; Olsen, Oystein; and Strom, Steinar, Analysis of Supply and Demand of Electricity in the Norwegian Economy, Statistisk Sentralbyra, Economic Study No.53, Oslo, August 1982.

Bonfiglioli, Gianpaolo, "Economics of Gas Imports to Europe from OAPEC", OGJ, Aus. 4, 1980, pp.55-58; adapted from "Export of Natural Gas", OAPEC Symposium, Algiers, 1980.

Brown F.C. and Hargreaves, H.G., "Coal Gasification -- Route to Ammonia and Methanol", Proceeding No.184, Fertiliser Society, London, October 1979.

Chiogioji, Melvin H., Industrial Energy Conservation, Marcel Dekker, Inc, New York and Basel, 1979.

Choksi, A.M.; Meeraus, A.; and Stoutjesdjik, A.J., Volume 2; The Planning of Investment Programs in the Fertilizer Industry, John Hopkins Press, 1980.

Drewry, H.P. (Shipping Consultants), Transport Costs for Shipping Petrochemicals. 1975-1983, UNIDO Report PC.49, Vienna, 20 July 1982.

Fesharaki, F. and Isaak, D., OPEC the World Refining Industry, Economist Intelligence Unit, London, May 1984.

Gale, George, "Ethylene Feedstocks: an End to Light Ends?", Chemical Business, June 29, 1981, p.19ff.

Gordon, Richard L., "Electricity for Aluminium in the Era of Expensive Energy", Collaborative Paper CP-83-32, IIASA, Laxenburg, June 1983.

Grosrichard, F., le Monde, 24 July 1984, pp.13-4.

Guinet, Jean, "Aluminium: Restructuring an Energy-Intensive Industry", OECD Observer, Sept. 1983, pp.3-8.

Gulf Organisation of Industrial Consulting and UNIDO, The Industrial Uses of Associated Gas, Vienna, April 1981.

Hashimoto, Hideo, "Bauxite Processing in Developing Countries", in Case Studies on Industrial Processing Primary Products, IBRD, Washington, 1983.

International Iron and Steel Institute, Seventeenth Annual Meetings and Conference - Podiums-Diskussionen/Reden, Vienna, 1983.

..............., Scrap and the Steel Industry, Brussels, 1983.

Kuwait Aluminium Co, K.S.C. (publisher), First International Arab Aluminium Conference, Kuwait, October 1983; herein designated ARBAL 1.

Middle East Economic Digest, Special Report: Saudi Arabia, November 1983 (London).

Mohamed, Ahmed Ibrahim, "Study on Governmental Incentives for National Industry in the Arab States", in ARBAL 1 (q.v.), pp. 666-705.

Organization of Arab Petroleum Exporting Countries, Secretary-General's Annual Report AH 1402/AD 1982, Kuwait, 1983.

Reda, Soliman, "The Egyptian Experience in application and Modification of Russian Technology in Nag Hammadi Smelter", in ARBAL 1 (q.v.), pp.124-49.

Rischard, J.F., Emerging Energy and Chemical Applications of Methanol; Opportunities for Developing Countries, IBRD, Washington, April 1982.

Robson, R.J., "Shipping of Bauxite and Alumina", Special Paper, International Bauxite Association, 1983.

Royal Commission for Jubail and Yanbu, Annual Report, Riyadh, annual.

Schramm, Gunter, "The Economics of Gas Utilization in a Gas-Rich Oil-Poor Country: the Case of Bangladesh", Energy 1, Vol.4, No.1, pp.47-64.

Stauffer, T.R., "Nuclear Power for the Oil-Exporting Countries", Uranium and Nuclear Energy: 1982, Processing of the Seventh International Symposium held by the Uranium Institute (1-3 September 1982), Butterworths, London, 1983.

Stauffer, T.R., "Gas Resources of the Middle East: Locational Implications for the Aluminium Industry", Conference on Structural Change in the World Aluminium Smelting Industry, IIASA, Laxenburg, 2 May 1984 (to be published by RFF, Washington).

........, "Energy-Intensive Industrialization in the Arabian/Persian Gulf: A new Ruhr without Water", Institute for International Political and Economic Studies, Teheran, March 1975.

........, "The Need for Nuclear Power in Oil-Exporting States", OPEC Review, Vol. 7, No.4 (Winter 1983), pp.357-80.

Turner, L. and Bedore, J., Middle East Industrialization: A Study of Saudi *and Iranian Downstream Interests*, Royal Institute of International Affairs, London, 1979.

UNIDO (Marian Racetzki), *Mineral Processing in Developing Countries*.

UNIDO, Development and Transfer of Technology Series No.11, *Technological Profiles on the Iron and Steel Industry*, Vienna, 1978.

Vivenzio, T.A., and Rossi, J. V., "Combined-Cycle Coal Gasification: Options for Power Plants", *Power Energy*, Vol.88, No.2 (February 1984), pp.57-59.

PERIODICALS, SPCIALISED NEWSLETTERS AND SERVICES

Bank of England, *Quarterly Bulletin*, London.
Metals Bulletin
Middle East Economic Digest (weekly)
Middle East Economic Survey (weekly)
Morgan Guarantee Trust, *World Financial Markets*