International Gas Pipeline Expansion Study

1995 Update

Prepared for the INGAA Foundation, Inc., by:
Derek Portsmouth
Derek Portsmouth Management Services
8 Church Hill
Purley, Surrey CR8 3QN
United Kingdom

F-9501

TABLE OF CONTENTS

Appendices

RESEARCHER'S NOTE

At its Mid-Year Meeting in San Antonio in May 1994, the INGAA Foundation received the International Gas Pipeline Expansion Study which was based upon the results of information searches reflecting sources reporting as at the end of January 1994. In welcoming the Study, it was suggested that an opportunity should be sought to prepare an update to the major aspects of the Study; and, to meet this request, further relevant information sources have been accessed so that the present document broadly reflects the updated position as reported up to the end of January 1995.

While this Study is intended as a stand-alone document, nevertheless, in certain respects, it should be read in conjunction with the 1994 Study as no attempt has been made to repeat some of the historical and background material and maps put together for that Study. The INGAA office in Washington DC retains a set of ten table-size colour maps covering energy infrastructure/developments (including gas pipelines) across the world.

Following the pattern of the 1994 Study, material is again reported under the same regional blocks comprising the same countries. Country placement in a particular regional block may, on occasion, be somewhat arbitrary given the difficulty of deciding, for inter-country developments, whether priority rests with the supply source or consuming state.

In the Researcher's Note to the 1994 Study, and reinforced at points throughout the body of the text, attention was drawn to the effect on reported pipeline developments of political uncertainty and volatility in many parts of the world covered by the survey. To demonstrate the continuing importance of these factors a section entitled Special Feature has been included within the 1995 Study. The Special Feature comprises a set of four vignettes dealing with the energy scene in Algeria, Chile, India and the Middle East (primarily Israel and Egypt). In each case the gas pipeline developments are considered in the context of the country's political and economic situation with particular attention to the emergence of cooperative attitudes within regional blocks reflecting, as appropriate, more relaxed political developments.

In the 1995 Study Update text, significant attention has been placed on consistency of reporting units. Generally, the important units for length, pressure and temperature are recorded in miles, psi and degrees fahrenheit respectively (except in a number of supporting tables and charts where for production convenience some information remains in SI format).

Recognising the reference value of the 1994 alphabetical listing by country of all known international pipeline activities and developments, this has been updated and filed as an appendix in this document; in view of the comprehensiveness of this listing, the supporting summary sheets in tabular form for each regional block have been omitted this year as being repetitive and therefore superfluous.

Bridging the 1994 and 1995 Studies was a presentation by the Researcher on International Pipeline Developments to the 5th Annual Meeting of the INGAA Foundation at Scottsdale, Arizona in November 1994. The text of this presentation is filed in the Appendices section of this document while a set of colour transparency slides supporting the presentation is held by the INGAA office in Washington DC.

OVERVIEW

While global energy consumption has remained almost static since 1990, demand for natural gas has continued to rise: its share of the primary energy market across the world has now reached 23% (or over 70 trillion cubic feet (tcf) in volume terms) according to the 1994 BP review of world gas. In 1993 gas was the only primary fossil fuel to show growth in total world consumption, remaining robust overall and capturing an increased share of every regional energy market. While demand in the Former Soviet Union (FSU) fell by over 5%, buoyant growth elsewhere was more than enough to compensate, yielding a global uplift of 1.4%. The stronger demand came from both the domestic sector, where a combination of population growth and continued extension of gas grids meant a greater requirement in both developed and emerging countries, and, the industrial sector, where demand for gas grew as a source of both heat and power generation. In the latter sector, lower plant cost, shorter build time and the superior conversion efficiency of gas fired CCGT have fundamentally increased the attractiveness of gas relative to other fossil fuels. Also, the environmental benefits of gas are becoming gradually more important as green legislation is implemented across the world. Combined with the convenience of gas once the infrastructure is in place, a strong potential demand is created generally if supplies can be made available at prices which are competitive with other fuels. Notably, the economics of gas transportation have led to gas supply infrastructure being developed on a regional basis, firing the need for production to be tailored to anticipate consumption also on a regional basis; and this was the case in 1993. As far as reserves are concerned, new gas finds continued to exceed production: the balance for 1993 leaving reserves up 2.7% at end-year, sufficient to supply world markets for 67 years at present production rates. The Middle East and the FSU together continued to dominate the reserves scene with over 71% of known gas supplies.

International trade in natural gas accounted for more than 11.5 tcf in 1993. Both pipeline gas and liquefied natural gas (LNG) trade rose in that year and together accounted for some 16% of total world consumption. Of this, around three-quarters was pipeline gas and the remainder LNG. The FSU is still the world's biggest gas exporter, accounting for some 29% of total exports, followed by Canada with 18%. The main importer is the USA with 19% of total trade followed by Germany and Japan. Pipeline exports from the FSU increased, mainly to the benefit of Western Europe. Canadian pipeline exports to the USA continued to rise sharply and now account for more than 10% of US demand. LNG trade is centred mainly in the Asia-Pacific region with about two thirds of exports destined for Japan, principally from Indonesia, Brunei, Malaysia and Australia but also from Abu Dhabi and the USA. Some 38% of LNG exports are from just one country, Indonesia. LNG trade as a proportion of world natural gas trade has more than doubled since the mid-1970s. In 1993 it rose to 2.98 tcf, equivalent to more than 25% of total trade. This increase is lower than in previous years, mainly as a result of economic recession in Japan.

Outside the US, Canada and Mexico/Central America pipeline mileage construction in 1993 was down to 2,434 miles, with the estimate for 1994 set at 8,893 miles, valued at $10.35 billion. This pace is expected to be maintained throughout the rest of the 1990s pushed by the growing domination of natural gas described earlier in this Overview. Analysis of international pipeline development shows that some 22,000 miles of gas transmission lines could be constructed over the next three years, of which 7,770 miles were underway at the end of 1994.

Beyond the next three year horizon there is a further 31,869 miles of construction in prospect reflecting the number of lengthy projects being considered to move gas thousands of miles from producing countries to potential consuming markets. More impressively, if oil -crude and products - is combined with gas then more than 83,000 miles of projects are under contract or planned for future construction.

The development of the gas market in 1994 has served to reinforce the move towards the dominance of the fuel which was described in the 1993 Overview, with particular emphasis being attached to the tilt to gas in national energy policies, and, the expansion and regionalisation of domestic gas distribution grids. There has been confirmation of the three major trends seen as transparent evidence for the growing importance of gas; namely: gas markets are certainly developing along continental or subcontinental lines; LNG continues to securely provide interregional supplies while awaiting the provision of pipeline grids; and the trend towards competition (often through the privatisation of government enterprise) shows no sign of abating. Unfortunately, the negative aspects of nationalism and protectionism - plus the degree of political instability identified in last year's survey - cannot be said to have improved materially; in particular, worries must be expressed about the position within the FSU and, indeed, within Russia itself. At the same time it is clear that governmental regulatory authority over environmental protection has gained momentum in both the developed and the developing world. Environmental awareness and potential liabilities have changed the way pipeline construction contractors undertake their work and the way business is conducted.

Europe

Gas markets in Europe are highly diverse with significant change been experienced across the board. While more mature markets such as those in the UK and in Germany are gradually deregulated, and Eastern European gas authorities are reformed and in some cases privatised, southern European countries such as Spain, Portugal and Turkey are seeking to expand their limited gas networks.

Gas consumption continued to grow throughout most of Europe, led by the UK where the demand from new gas fired power generating capacity resulted in a 15.2% increase. Rejuvenation of former Comicom economies was reflected in renewed demand growth, and the extension of the gas grid in the former GDR contributed to the 5% increase in German demand. Relatively flat Spanish consumption resulted from constrained supply rather than lack of demand. According to many reports, the demand for gas will increase throughout the second half of the 1990s. Some industry estimates indicate that more than 40% of European Union consumption will be supplied from outside the Union.

While demand for natural gas in the region has grown, as indicated above, financial and political obstacles have to be overcome before key pipeline systems can be built. It is this growing demand for clean-burning fuel throughout Europe that is driving construction of natural gas projects from the FSU, North Africa and the North Sea. Extreme distances of gas reserves from the area of demand means that substantial investments for more varied sources are required to bring natural gas to market. In Europe, most of the current - 1,666 miles - and future - 10,540 miles - work relates to transporting natural gas from North Sea and Algerian sources. Zeepipe 2, Europipe and Haltenpipe now share the spotlight with the Europe - Maghreb activity. Statoil hopes to convince other Zeepipe owners to alter phase 2 of that

system in order to provide additional capacity. The Europe - Maghreb project is looking at extending into France and Germany. And Middle East producers are examining potential routes to Europe. Looking east, rebuilding and development programs are taking place in Europe to transport and distribute gas (along with crude oil), associated with which is the Gaz de France study of ways to integrate the central/eastern European gas networks with those of western Europe. Russia's Gazprom continues to plan new lines from Siberia and has reached agreement with Poland on pipeline transit through that country to Germany and construction work has commenced.

Over-arching all of this progress is the relentless pressure for higher priced gas which clearly is a factor affecting the growth of the pipeline construction industry. Within the European Union there are efforts to make energy prices competitive for less fortunate members of the union. However, producers and pipeline builders maintain that higher costs justify higher prices. Providing the resources needed to develop the new generation of large fields e.g. offshore northern Norway, in the Caspian Sea area and from the Yamal Peninsula, and to bring gas to market, will be a major industry test.

Former Soviet Union (FSU)

FSU gas consumption fell for the third consecutive year, notably in Russia and the Ukraine, driven largely by lower deliveries to power stations. Energy consumption remained relatively high throughout the FSU in an environment of declining GDP and gas's share of total energy usage increased to nearly 48%. Exports from the FSU grew slightly although disputes continued between Russia and Ukraine over payment for gas sales and carriage. The increase in exports was not enough, however, to offset the decline in internal demand, resulting in a fall in production. Russia supplied an increased share of the FSU's net gas exports. Elsewhere, Turkmenistan's output recovered slightly from its 1992 low level and its production increase was absorbed by the other FSU republics.

Pipeline conditions in the FSU remain unsettled. Considerable western interest has been expressed in gas (and oil) operations, and several joint operating agreements have been signed. However, activity has declined due to continued economic crisis - current work amounts to 540 miles - but interest remains high on a number of new projects and rehabilitation of existing lines: future work forecast is 5,537 miles. A number of large-diameter lines to move gas to Europe, Korea, Japan and China are on the drawing board. Due to economics and political influences, the direction of these lines are in a continuous state of change. Two trans-Siberian lines, already referred to under Europe above, are in the planning state. Each line, from the Yamal Peninsula to markets in Europe, would be an estimated 1,864 miles long. However, all is not plain sailing for Russia's far east gas development projects. Clearly a key factor in establishing a gas pipeline network in northeast Asia is finance, and regional politics will influence financial decisions. If the final verdict on the silk route project (Turkmenistan - China Tarim), about which much is written elsewhere in this survey, is positive, substantial quantities of Turkenistan gas could reach northeast Asia by 2001. Under these circumstances, a serious delay in east Siberian, (and Yakutian) gas development will be inevitable.

South America

In 1993, gas met close to 20% of South America's primary energy demand. Despite steady additions to identified reserves, the region's gas production has remained modest and been concentrated in Argentina and Venezuela. Limited international transportation infrastructure has led to gas consumption being similarly localised. Argentina has, for the moment, the only developed residential/commercial gas sector, although slightly more gas goes to its power generating industry while Venezuela demand is led by local chemical and heavy industries. This pattern, however, may change as economic growth and increasing environmental concern drives gas penetration upwards in several countries (such as Chile) following the 7.5% jump in demand in 1993 across the region. In Argentina, where gas exceeds 40% of energy consumption, European investors in the privatised gas network have announced major infrastructure investment plans, including a potential pipeline to Chile. In Columbia, dependence on hydroelectricity has led to unreliable power supply during droughts: the doubling of the country's known gas reserves over the past three years may offer a tempting alternative. Environmental factors are particularly important in Chile and Brazil where air quality in the cities has become a concern to the extent that indigenous gas resources may be exploited. In the meantime Brazil has signed an import agreement with Bolivia, and discussions are in hand about joint development with Argentina of this latter country's reserves close to the Brazilian border.

All of this serves to emphasise the point, brought out in the previous survey, that regional pipelining here ranks among the most interesting in the world given the history of nationalistic government tendencies and long standing disputes over international borders. However, moves to integrate economics have side lined many of these problems with a number of international projects in the planning stage. Work currently in hand amounts to 480 miles of pipeline while that associated with future projects totals 8,062 miles. Several of these latter projects, such as Bolivia to Brazil, Argentina to Chile, and, Argentina to Uruguay/Paraguay, now reaching the front burner, have been under consideration for ten years and longer.

Pacific Rim and Far East

These two geographic blocks, considered separately for reporting purposes in the detail of this survey, are often otherwise described as Asia Pacific. Asia Pacific comprises a number of distinct regions, from the Indian Subcontinent to Australasia, incorporating some of the richest as well as some of the world's poorest nations. It is characterised by diverse economies at different stages of economic development, reflected in the varying maturities of their gas markets. The region carries half the world's population, but presently only consumes a quarter of its primary energy. Economic growth and increasing urbanisation are likely to drive energy demand in the less developed Far Eastern countries towards the levels of their wealthier neighbours. After several years of rapid growth in excess of 6% a year, gas demand across the region rose by a more modest 3.8% in 1993. This was largely a result of significant slowing of demand growth in Japan due to disadvantageous climatic and economic conditions. Other countries, such as Malaysia and Thailand, continued to record gas growth rates of more than 10% mainly driven by demand for power generation. Significantly, the Chinese economy has achieved rapid growth but this has not been reflected in its gas demand due to a combination of improved energy efficiency, reduced energy intensity and artificially low prices. For Asia Pacific, it has to be remembered that, in the absence of a developed pipeline structure, and,

given the heavy dependence of Japan especially upon LNG imports, meeting demand puts pressure on production: in 1993 production rose slightly more quickly then consumption.

Throughout the region natural gas is fuelling the drive to build pipe lines to meet internal and external demands. In the South Pacific, Australia's future plans involve a number of projects that eventually will develop into a national gas grid. In south-east Asia, Malaysia and Thailand have major pipelines underway or planned to meet internal power generation needs as well as for export to yield much needed revenue. In the Far East, Japan and Korea are seeking help from long distance, large-diameter lines to bring in gas from other regions, particularly FSU gas.

Taking the region as a whole 3,338 miles of pipeline work is currently in hand while a massive 20,692 miles is classified as future workload. This reflects the fact that long distance gas transmission, gathering and lateral networks, along with substantial - if tentative - projects to supply FSU gas to Korea and Japan, hold the future for pipeline construction. In this category is the out-of-favour 4,865 mile Trans Asean system although individual countries are moving ahead with projects that could serve as major links should the proposal resurface later. The most ambitious plans are being laid by East Asian interests with Asian companies participating in mainly Middle East gas projects as customers, financiers and suppliers. Plans abound - especially concerning the Subcontinent - for pipeline (and LNG) projects. However, in many of these cases, there are difficult political, as well as commercial, obstacles to be overcome. On the other hand, probably the most comprehensive proposal to date is for an Asian pipeline grid extending from Alaska to Australia and westward as far as Kazakhstan. It is now generally recognised that such a system might more realistically evolve naturally if the smaller domestic systems proposed for Thailand, Indonesia, China, Malaysia, Japan and Korea were to be developed and then subsequently linked to each other in response to economic needs. For example, China is expanding its pipeline systems with more outside help than ever in its history. By end 1993, 4,800 miles of natural gas lines had been built while the country's open-door orientation includes a 2,100 mile joint venture gas line from mid-Asia (in Turkmenistan) to China's eastern coastal provinces where the gas would be liquefied for export.

Middle East and Africa

The Middle East accounts for under 5% of global gas consumption despite holding over 30% of world gas reserves. Demand, concentrated in Iran, Saudi Arabia and the United Arab Emirates, comes mainly from the power generating and industrial sectors, distribution networks to commercial and residential consumers being limited. Distance from the main gas consuming markets creates a considerable barrier to export: although a number of major projects are under consideration, the costs and risks involved are substantial. At the moment the only significant international gas trade is Abu Dhabi's export of LNG to Japan, although another LNG project is under development in Qatar, which has the world's largest offshore gas field. As the global gas market continues to show robust growth, possible future Middle Eastern exporters include Iran (with the second largest gas reserves in the world) and Oman, whose reserves, although much smaller, have been revised upwards rapidly over the past two years.

In the other part of the region, Africa, gas reserves fell a little in 1993, after a growth of 12% the previous year, and remain concentrated in Algeria, Libya and Nigeria. Algeria is currently the only major producer and consumer of natural gas although Egypt is now moving towards

that status. Inevitably commentary revolves around Algeria - in political turmoil - given its history in the LNG export marketplace; investment is currently underway which should substantially increase its gas export volumes, especially by pipeline as rising consumption in Italy has prompted an increase in capacity of the Transmed Pipeline and construction of the Maghreb Europe pipeline.

The Middle East is set to hold a strong pipelining position for current - 555 miles - and future - 5,614 miles - construction to meet internal natural gas demand. Looking outside there are aggressive ambitions with the feature project being Oman's plans to move gas across the Arabian Sea to India (about which there now seem to be some doubts). Similarly, European gas demand needs coupled with regional requirements are fuelling North Africa as a prime pipeline construction arena. Present activity chalks up 1,191 miles of work while through 1995 and beyond things could be really busy with a further 3,524 miles of construction.

Trade flows by pipeline 1993

(bcm)

EXPORTER												
USA	Canada	Bolivia	Mexico	Denmark	Germany	N'lands	Norway	UK	FSU	Iran	Algeria	Malaysia
1.42	60.94		0.03									
1.05		2.23										
				1.61	1.50	43.10	24.64	0.28	100.90		13.88	
										0.50		
											0.55	
												1.50
2.47	60.94	2.23	0.03	1.61	1.50	43.10	24.64	0.28	100.90	0.50	14.43	1.50

IMPORTER	Total Imports
North America	62.39
Latin America	3.28
Europe	185.91
FSU	0.50
Africa	0.55
Asia & Australasia	1.50

Trade flows by ship 1993

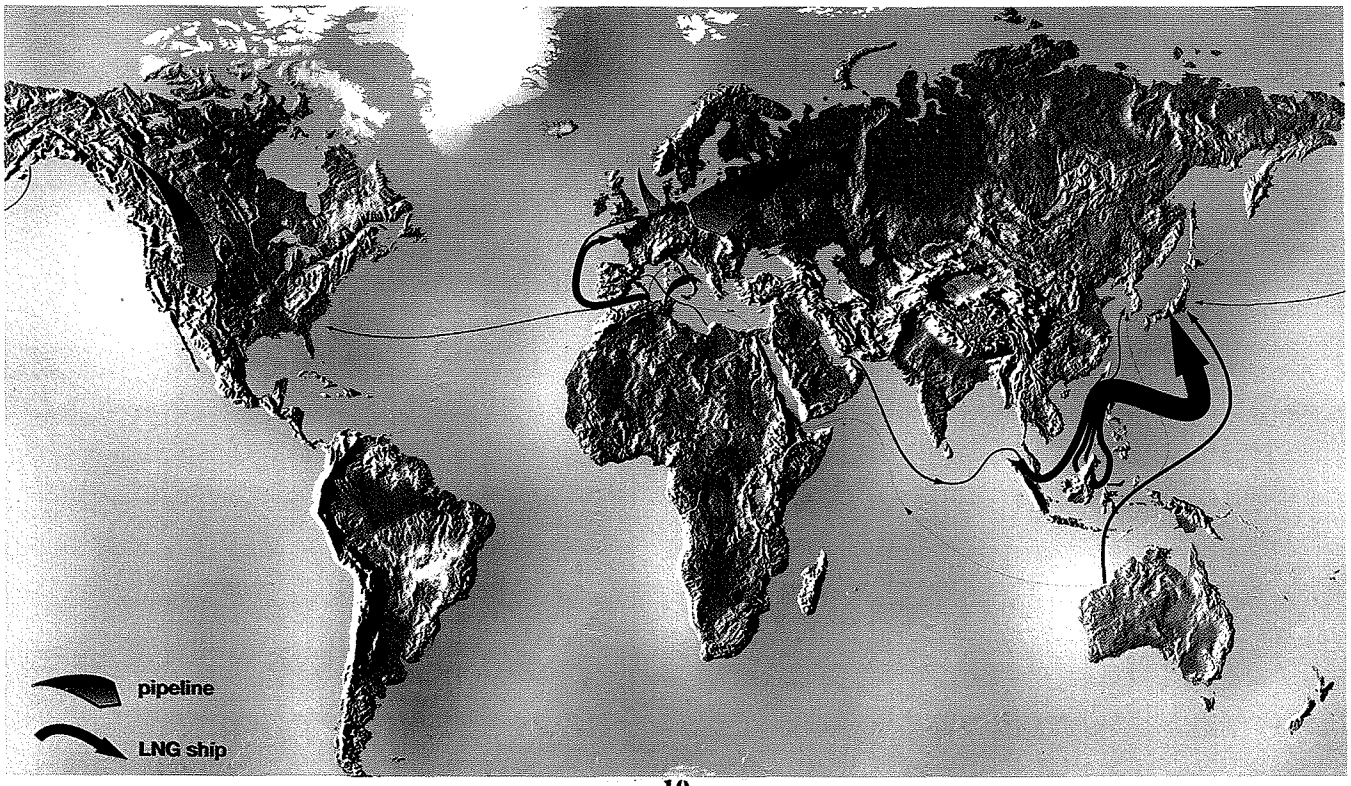
(bcm)

EXPORTER							
USA	UAE	Algeria	Libya	Australia	Brunei	Indonesia	Malaysia
		2.32					
		17.93	1.60	0.04			
1.41	3.35			6.65	7.54	31.93	10.47
1.41	3.35	20.25	1.60	6.69	7.54	31.93	10.47

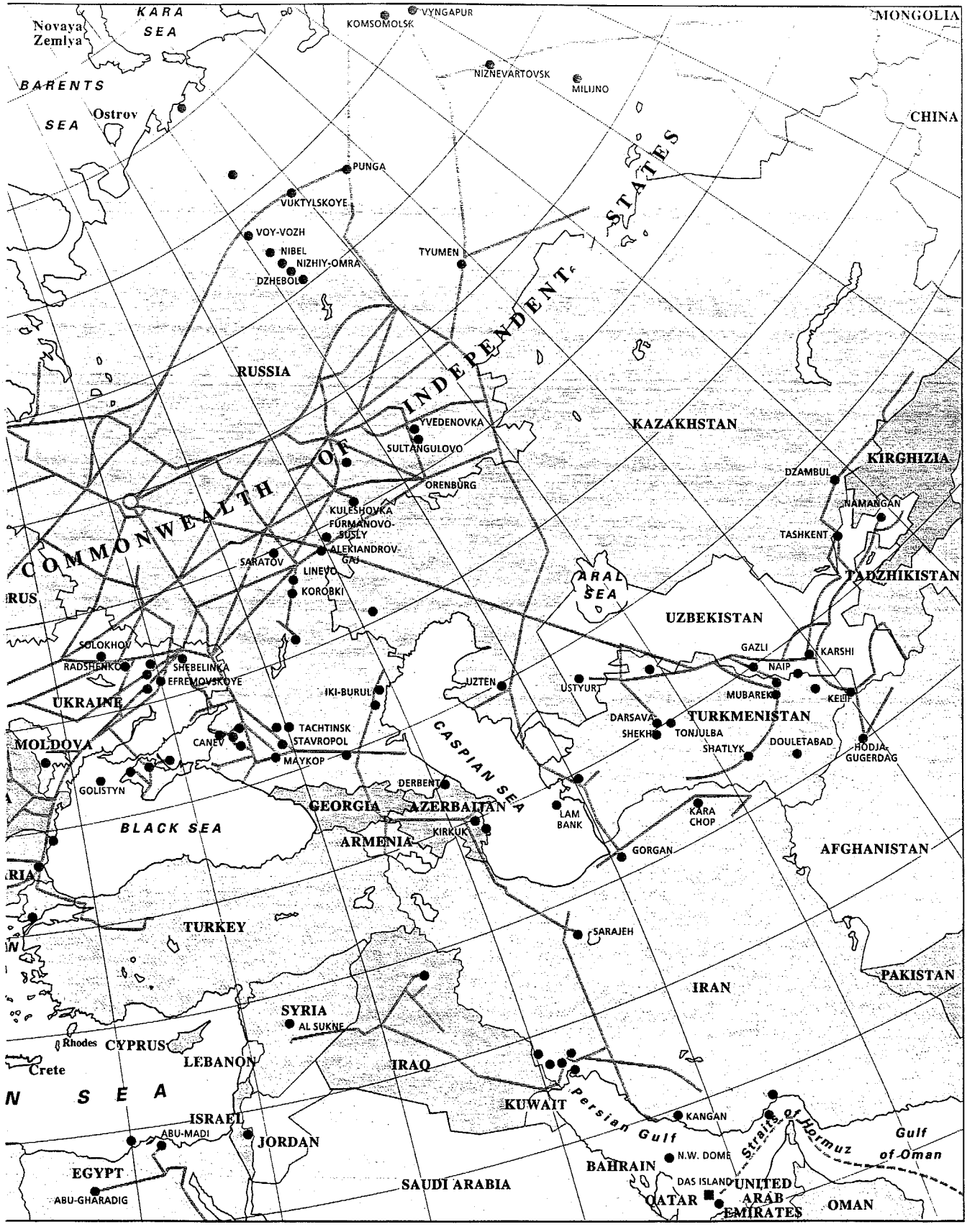
IMPORTER	Total Imports
North America	2.32
Europe	19.57
Asia & Australasia	61.35

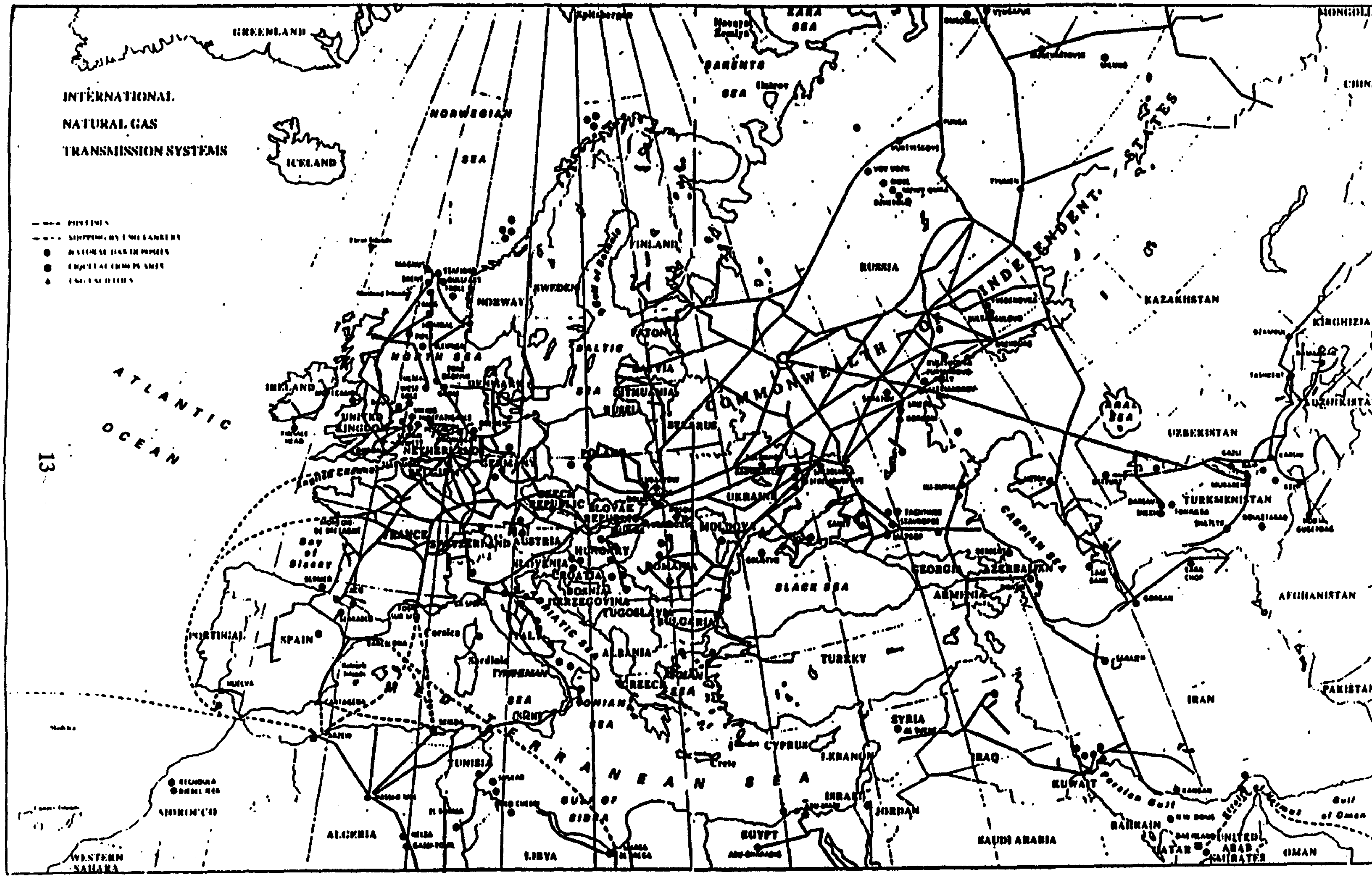
Trade flows worldwide

(bcm)




INTERNATIONAL
NATURAL GAS
TRANSMISSION SYSTEMS
PIPELINES
SHIPPING BY LNG TANKERS
NATURAL GAS DEPOSITS
LIQUEFACTION PLANTS
LNG FACILITIES
GREENLAND
Spitsbergen
ICELAND
NORWEGIAN SEA
Faroe Islands
Shetland Islands
MAGNUS
STAFJORD
BRENT
GULLFAKS
TROLL
FRIGG
HEIMDAL
PIPER
SLEIPNER
FINLAND
SWEDEN
NORWAY
Gulf of Bothnia
ESTONIA
BALTIC SEA
LATVIA
LITHUANIA
NORTH SEA
ZONE EKOFISK
FULMAR
WEST SOLE
GORM
DENMARK
IRELAND
MORECAMBE
ROUGH
VIKING
INDEFATIGABLE
PLACID
LEMAN
HEWETT
BREMEN
GRONINGEN
UNITED KINGDOM
KINSALE HEAD
LONDON
NETHERLANDS
ZEEBRUGGE
BELGIUM
GERMANY
POLAND
RUSSIA
BELA
ATLANTIC OCEAN
English Channel
LUBACZOW
CZECH REPUBLIC
SLOVAK REPUBLIC
DOLINA
KOSOV
KRASNOILSK
SALUSHSK
MONTOIR-DE-BRETAGNE
FRANCE
SWITZERLAND
AUSTRIA
HUNGARY
Bay of Biscay
SLOVENIA
CROATIA
ROMANI
BERMEO
LACQ
BOSNIA-HERZEGOVINA
LA SPEZIA
FOS SUR-MER
SERRABLO
YUGOSLAVIA
BULGA
PORTUGAL
SPAIN
Corsica
ITALY
ADRIATIC SEA
BARCELONA
ALBANIA
Sardinia
TYRRHENIAN
Balearic Islands
HUELVA
GREECE
SEA
CARTAGENA
MEDITERRANEA
IONIAN
SEA
Sicily
Madeira
SKIKDA
ARZEW
TUNISIA
MISKAR
KECHOULA
DJEBEL-JEER
HASSI-R-MEL
OUED-CHEBBI
GULF OF SIDRA
Canary Islands
MOROCCO
EL BORMA
ALGERIA
NELZA
GASSI-TOUIL
LIBYA
MARSA EL BREGA
WESTERN SAHARA


KARA SEA
Novaya Zemlya
BARENTS SEA
Ostrov
KOMSOMOLSK
VYNGAPUR
NIZNEVARTOVSK
MILIJNO
MONGOLIA
CHINA
PUNGA
VUKTYLSKOYE
VOY-VOZH
NIBEL
NIZHIY-OMRA
DZHEBOL
TYUMEN
INDEPENDENT STATES
RUSSIA
YVEDENOVKA
SULTANGULOVO
KAZAKHSTAN
KIRGHIZIA
DZAMBUL
NAMANGAN
TASHKENT
TADZHIKISTAN
ORENBURG
KULESHOVKA
FURMANOVO-SUSLY
ALEKIANDROV-GAI
SARATOV
LINEVO
KOROBKI
COMMONWEALTH OF
ARAL SEA
UZBEKISTAN
GAZLI
KARSHI
NAIP
MUBAREK
KELIF
USTYURT
UZTEN
IKI-BURUL
SOLOKHOV
RADSHENKO
SHEBELINKA
EFREMOVSKOYE
UKRAINE
TACHTINSK
STAVROPOL
CANEV
MAYKOP
CASPIAN SEA
DARSAVA
SHEKH
TONJULBA
TURKMENISTAN
SHATLYK
DOULETABAD
HODJA-GUGERDAG
MOLDOVA
GOLISTYN
DERBENT
GEORGIA
AZERBAIJAN
LAM BANK
KARA CHOP
BLACK SEA
ARMENIA
KIRKUK
GORGAN
AFGHANISTAN
TURKEY
SARAJEH
PAKISTAN
IRAN
SYRIA
AL SUKNE
Rhodes
CYPRUS
Crete
LEBANON
IRAQ
KUWAIT
Persian Gulf
KANGAN
Straits of Hormuz
Gulf of Oman
ISRAEL
ABU-MADI
JORDAN
BAHRAIN
N.W. DOME
DAS ISLAND
UNITED ARAB EMIRATES
QATAR
OMAN
EGYPT
ABU-GHARADIG
SAUDI ARABIA


INTERNATIONAL
NATURAL GAS
TRANSMISSION SYSTEMS
GREENLAND
ICELAND
NORWEGIAN SEA
BARENTS SEA
KARA SEA
ATLANTIC OCEAN
NORTH SEA
BALTIC SEA
IRELAND
UNITED KINGDOM
NORWAY
SWEDEN
FINLAND
ESTONIA
LATVIA
LITHUANIA
BELARUS
POLAND
GERMANY
NETHERLANDS
FRANCE
SPAIN
PORTUGAL
SWITZERLAND
AUSTRIA
CZECH REPUBLIC
SLOVAK REPUBLIC
HUNGARY
SLOVENIA
CROATIA
BOSNIA HERZEGOVINA
YUGOSLAVIA
ROMANIA
BULGARIA
ALBANIA
GREECE
UKRAINE
MOLDOVA
RUSSIA
COMMONWEALTH OF INDEPENDENT STATES
KAZAKHSTAN
UZBEKISTAN
TURKMENISTAN
KIRGHIZIA
TADZHIKISTAN
CHINA
MONGOLIA
AFGHANISTAN
PAKISTAN
IRAN
IRAQ
SYRIA
LEBANON
ISRAEL
JORDAN
CYPRUS
TURKEY
GEORGIA
ARMENIA
AZERBAIJAN
BLACK SEA
CASPIAN SEA
ARAL SEA
MEDITERRANEAN SEA
TYRRHENIAN SEA
IONIAN SEA
Bay of Biscay
Persian Gulf
Gulf of Oman
Gulf of Sidra
Corsica
Sardinia
Crete
MOROCCO
ALGERIA
TUNISIA
LIBYA
EGYPT
WESTERN SAHARA
SAUDI ARABIA
KUWAIT
BAHRAIN
QATAR
UNITED ARAB EMIRATES
OMAN

Background

In 1993 European gas demand grew by 6.2%, driven by a 15% increase in Britain, which is now Europe's biggest consumer. Actually, gas consumption in Europe has increased by an average 2.5% over the last decade reflecting the commercial and environmental advantages of natural gas over alternative fuels. And there is still potential for growth in every sector of the industry: domestic, industrial and commercial customers are increasingly attracted by cleaner-burning gas. Notably, the tremendous potential for gas in the power generation industry which will become more apparent as capital stock begins to turn over and new power stations are built. New gas-fired power plants offer much higher efficiencies and lower capital and operating costs. For all these reasons it is expected that demand for natural gas will grow in western Europe by 50% over today's level within 20 years. This makes the matter of the sources to meet the increased demand of great importance.

In western Europe, some two-thirds of the gas consumed comes from indigenous production. About 10% is imported from Algeria with the remainder coming from Russia.

Indigenous sources, particularly the Netherlands, the UK and Norway should continue to play a major role in supplying Europe's gas. Maintaining this secure supply will require significant investment over many years. However, the contribution these countries make will probably decline from 50% to 30% by the year 2010 when the prospect is of having to import more gas from outside Europe from existing suppliers - the Former Soviet Union and Algeria - and from new suppliers. Among the new suppliers could be the Middle East, which is a potentially large exporter of gas and countries in the region are only beginning to explore that potential, and, to a lesser extent, West Africa and Latin America. However, substantial penetration of the European market by new long-haul suppliers may only come when prices in Europe begin to reflect the costs of transporting gas over the great distances involved. And, of course, the geographical location and the history and political nature of many of these resource holders add to concerns about security of supply. This is an underlying concern which leaps into the spotlight from time to time when the market perceives the possibility of disruptions. Consuming areas, including Europe, will need to build mutually beneficial relationships with producer countries to establish reliable sources of supply.

For the purposes of this survey, as for the 1994 edition, some of the issues mentioned or implied above are covered elsewhere - especially the Former Soviet Union and the Middle East. However, detailed information materialising during 1994 about progress on several of the more important of these developments is set out below.

(1) Maghreb Gas Pipeline

The European Investment Bank (BEI) has granted a loan of $200 million to Europe Maghreb Pipeline Ltd (EMPL), for construction of the section of the Maghreb Europe pipeline to be built in Morocco. Signature of the contract for this loan between BEI and EMPL, and the warranty backing the operation between BEI, the Instituto Nacional de Hidrocarburos (INH) and ENAGAS, took place in October 1994.

The above amount is part of a credit line for up to $530 million authorised by the BEI to EMPL in July 1993 to pay for the Maghreb pipeline. This loan will be paid out in various tranches and the amount disbursed at this stage is 37.7% of the whole. The economic aid granted by the BEI is guaranteed by the INH and ENAGAS and covers 45% of the overall investment of $1,100 million to be made on the Moroccan stretch of the Maghreb-Europe pipeline.

EMPL was founded in July 1992 and holds the right of transit for the pipeline in Morocco and the Straits of Gibraltar. April 1994 witnessed the creation of SAGANE in which the INH holds a 91% and ENAGAS 9%. Controlled by INH, SAGANE, owns 100% of EMPL which is responsible for financing the pipeline's construction. It is also in charge of the supply contract for Algerian gas and 70% of METRAGAZ (Maghreb-Europe Transport de Gas), which is the company set up to conduct its construction in Morocco.

JP Kenny has won the construction management and supervision contract for the pipeline which will cross the Straits of Gibraltar. Europe Maghreb Pipeline Ltd (EMPL) has awarded the contract which includes the provision of all construction management personnel, as well as systems to oversee on behalf of EMPL the performance of the main offshore construction contractor, Saipem.

The award of this contract is a hat trick for JP Kenny following the completion of the preliminary phase by the company in a joint venture with Sofregaz and Beicip and the detailed engineering in a joint venture with Intecsa.

The project involves laying twin 22-in lines for 30 miles across the 1200 feet deep straits at the mouth of the Mediterranean with landfalls in Morocco and Spain.

Route preparation started in July 1994 with pipelay scheduled by end-year. Construction is for completion to meet the October 1995 deadline for gas to flow through the pipeline from Algeria, through the kingdom and on to Spain.

EMPL awarded a $28.4 million contract to supply pipe for the undersea section to British Steel. The order was for more than 60 miles of 22-in welded line pipe for delivery in Summer 1994. Three wall thicknesses, ranging from 6 ¼in to 10in were required to take account of differing water depths. To meet these specifications British Steel invested in special tooling at its recently commissioned Hartlepool pipe mill. A subcontract for pipe coating and fitting of anodes went to the Leith-based British Pipe Coaters.

The Spanish gas company Enagas has awarded the first contracts for overland sections of the project. The first contract is for a 338 mile stretch from the Algerian border with Morocco to the Straits of Gibraltar. This contract is divided between a consortium of Entrepose of France and the Daipsa joint venture of Dragados and Auxini covering 174 miles, and a consortium of Formento de Contratas y Construcciones and Mannesmann AG covering 155 miles. Overall responsibility rests with Sonatrach and the contract is valued at $180 million. Work is expected to start in early 1995 and be completed by July 1996 (indeed, this contract which Sonatrach has with Bechtel has a 24 month completion clause). Security remains an increasing problem in Algeria (see the further

material in the Special Feature section of this review). At the same time EMPL has ordered four Coberra 6000 gas turbine compression sets, driving Cooper-Bessemer centrifugal compressors, for installation at stations near Frontera and Estrecho, Morocco. Scheduled delivery was third quarter 1994, with site completion in third quarter, 1995.

The second contract, worth $93 million, was awarded to the consortium of Gines Navarro and OCP of Spain for sections of the 167 miles of line between Cordoba and Tarifa. A later phase will see lines built from Cordoba to north of the Pyrenees and from Cordoba to Setubal in Portugal to feed that country's gas expansion progam.

(2) Austria

(a) Rohol-Aufsuchungs A.G. plans a gas line from Burghausen in Germany to Puchkirchen in Upper Austria to be called the ABG Austrian Bavarian Gasline. It will have a capacity of 108 bcf a year and cost $58 million. Participants include Bayenwerke, Shell, Mobil and BVN the Austrian regional utility.

(b) It has been established that work will now begin in 1995 on upgrading the gas pipeline distribution system of Graz, the country's second-largest city. The cost is estimated at $50 million. The network runs about 250 miles, and about 75 miles of that will be upgraded, including about 50 miles of replacement.

(3) Belgium (incl Luxemburg)

Distrigaz has the following gas lines planned/under study:

- 4 miles of 10in line from Sint Gillis Waas to Sint Niklaas
- 4 miles of 10in line from Willebroeck to Boon
- 63 miles of 16in line from Dalhem to Bastogne
- 32 miles of various size miscellaneous lines
- 60 mile line from Berneau to Bastogne awaiting authorisation to begin construction

Distrigaz completed in December 1994:

- 4 miles of 10in line in Gent
- 20 miles of 12-20in line from Lichtervelde to Niewpoort (cost $11 million)
- 6 miles of 22-30in line from Loenhout to Rijkevorsel

Tractabel, Belgium's biggest utility is pushing for growth outside its domestic energy markets. Projects under consideration are gas pipelines in Argentina and Oman.

(4) Bulgaria

(a) The Bulgarian Committee on Power Engineering has reached agreement with Gazprom, Gazexport and others to set up a 50/50 company to build and operate a $2 billion gas pipeline carrying 215 bcf/year of Russian gas through Bulgaria.

(b) In April 1994 reports emerged about an agreement between Bulgaria and Iran to construct a pipeline to supply western Europe with gas. A news conference was told that the two countries had agreed a gas pipeline to link Bulgaria and Iran via Turkey but declined further details except that Iranian experts has already started work on the project and that the section to pass through Bulgaria would be built by Bulgarian workers. Certainly, such a pipeline would reduce Bulgaria's dependence on Russia - its main supplier of gas - as it has little indigenous deposits to meet current annual needs of about 230 bcf.

(5) Denmark

(a) Dansk Olie has

- under design a 5 mile 12in gas line from Kalvebod to the HCV power plant
- under study a 15 mile 12in gas line from Milov to Svnnemollen

(b) Naturgas Syd. plans 2,435 mile expansion of the gas distribution system for southern Denmark.

(6) Finland

(a) In a striking change of direction from the position reported in the 1994 study, in April 1994 it emerged that Statoil of Norway and Neste Oy of Finland had resumed their discussions on a project to construct a gas pipeline from Norway to Finland across Central Sweden. The pipeline would then continue to Estonia and from there to Riga, the site of a major gas storage facility. Scandinavia and the Baltic countries would thus have guaranteed access to gas supplies. However there is no indication that construction is imminent of the estimated $242 million line from Uuslkaupunki to Gravle.

According to data released by the Swedish press, Finland has a network of pipelines carrying Russian natural gas until the year 2000 under an agreement with Russia's Gazprom. Finland, however, is interested in taking delivery of gas from Norway. Neste then plans to lay a gas pipeline from Helsinki to Tallinn and then connect it to pipelines through which Russian gas is transmitted to Estonia. If the project comes to fruition it would mean an end to the complete dependency of the countries of the European north on Russian gas supplies.

After Sweden and Finland become members of the European Union (EU) on January 1, 1995, they will then be eligible for financial support from EU funds in order to construct the pipeline.

(b) The Council of Ministers of Northern Countries is also considering the issue of the "northern gas market" with the active participation of the Baltic states. In the event of the project's success the Baltic states will no longer be totally reliant on Russian gas supplies. The EBRD has recently backed Estonia in its intention to consider the issue of laying a pipeline from Finland.

(c) Neste Oy has contracted E.M. Pekkinen Oy to build $10 million 26 mile extension of the company's Southern Finland gas line into greater Helsinki (with welding and fitting work to be handled by Russia's Zarubezhjneftegasstroi).

(7) France

(a) In mid-1994 it was announced that under a new 20 year contract, Norway will gradually increase its gas shipments to France, beginning in 1996, to an annual plateau of 144 bcf. This will complement the 288 bcf/yr to be supplied under the Troll gas sale agreements, under which deliveries began in October 1993 as well as the gas now purchased by France from the Gullfaks, Ekofisk, Statfjord, and Heimdal areas.

This means that France will be importing 468 bcf/yr of Norwegian natural gas by the end of the decade. The increased supply is necessary to met French demand, which grew 4% in 1993 and is expected to continue to expand and for which an expansion of France's supply system will be required,

Two options are being considered. The first would include a second pipeline from Emden, Germany, and an increase in the capacity of the Zeebrugge pipeline, either by reinforced compression stations or a second pipeline. The other possibility involves, again, a second Emden pipeline, and a fourth submarine pipeline to France, possibly terminating at Dunkirk.

(b) Gaz du Sud Ouest expected to complete at end 1994

- 110 miles of 32in line from Toulouse to Narbonne - Argeliers
- 30 miles of 12in line from Toulouse - Selib to St. Sulpice

(8) Germany

(a) Early in 1994 Trans Europa Naturgas Pipeline GmbH (TENP), Essen, gave fresh details of its plans to expand substantially its 310 mile gas pipeline system which stretches from the German-Dutch border near Aachen to the Swiss-German border at Schwoerstadt. By 2000 the company will have enlarged the 170 mile southern section between Mittelbrunn/Landstuhl and the Swiss border, through successive laying of parallel lines of about 60 miles. TENP will invest more than $171.3m in the scheme. It has been made necessary by rising demand for gas in south-western and southern Germany and in Switzerland.

Ruhrgas AG, Essen, had already concluded major supply contracts to meet this demand. TENP is a joint venture of Ruhrgas and Snam SpA, Milan (a subsidiary of Eni SpA, Rome). The announcement follows closely after Ruhrgas rival Wingas, Kassel, the joint venture of Wintershall (65%) and Gazprom (35%) unveiled plans to extend its major Midal pipeline further southwards beyond the present terminal at Ludwigshafen, by using a disused oil pipeline up to Jockgrim/Woerth. This will allow Wingas to supply customers in the upper Rhine area.

However, TENP had already started its expansion in 1993. An initial 10 mile section in the southern Rhine Valley from Tannenkirch/Kandern to Huesingen/Loerrach was commissioned in autumn 1993. It linked up with an earlier 10 mile parallel line between Huegelheim and Tannenkirch. Two lines are to be built in 1994, parallel to existing pipes: the 14 mile section in Rhineland-Palatinate between Mittelbrunn and Merzalben and the 10 mile section in Baden-Wuerttemberg between Schwarzach and Rheinbischofsheim. Construction started in summer 1994 and commissioning was scheduled for October. The pipes will have a diameter of 40in.

(b) Ruhrgas AG and Verbundnetz Gas AG (VNG) started work in Spring 1994 on the construction of a new 115 mile 42in gas pipeline from Salzwedel to Bernau. $30 million is being invested in the project, with each partner providing half of the investment. The pipeline is scheduled to go into operation in December 1994.

(c) Ruhrgas AG projects in hand are:

- 16 miles of 16in line from Laimerstadt to Denkendorf; completion end 1994
- 5 miles of 12in transmission loop between Bonn and Euskirchen; completion end 1994
- 99 miles of 32in line from Breitbrunn to Anwalting (joint venture with Bayerngas); completion end 1995
- 51 miles of 48in line from Achim to Wardenberg (joint venture with BEB Erdgas and Erdol); completion end 1994
- 74 miles of 44in gas lines between Drohne and Werne; for construction during 1995
- 8 miles of 12in gas distribution line in the Messenkamp area (contractor, Pipeline Engineering GmbH), completion end 1994
- 35 miles of 48in line from Etzel to Wardenberg; for construction during 1995

(d) Gasvergsorgun Suddeutschland GmbH plan for completion in October 1995 a 16 mile 20in gas line from Scharenstetten to Allmendlingen (contractor, ILF Munchen) and a 19 mile 16in gas line from Pfullendorf to Nenzingen.

(e) Bayerngas GM projects in hand are:

- 53 miles of 28in transmission and distribution lines at Nordumgehung von Munchen, costed at $85 million; completion October 1995

- 43 miles of 32in gas line from Lehringen to Kolshorn
- 75 miles of 24in gas line from Kolshorn to Egenstedt; completion end 1994
- 10 miles of 8in gas line from Bramsche to Neuenkirchen; planned

(f) Preussag Anlagenbau GmbH projects in hand are:

- 33 miles of 24in transmission line from Ahltan to Saltgitter; completion end 1994/early 1995
- 85 miles of 36 in gas line; for construction during 1995.

(g) Completion is confirmed of the 397 mile 32-40in. MIDAL gas line between North Sea coast location Emden and Ludwigshafen in southwest Germany. A joint venture project of Wintershall and Gasprom (Wingas), costing about $1.9 billion, MIDAL connects with the joint ventures's STEGAL (Sachsen - Thuringen - Erdgas Leitung) pipeline - that will move Russian gas into Eastern Germany - and with Winterhall's Rehden gas storage site close to the North Sea coast.

(9) Greece

(a) Construction has been completed in 1994 - a year ahead of schedule - on a 325 mile 30in gas transmission line bringing former Soviet Union gas from the Bulgarian border town of Kulati, over Thessalonika to Athens. This major project - part of Greece's $1.3 billion gasification programme - required the construction companies to deal with a wide range of extremely difficult conditions, as the line runs primarily over rocky and mountainous terrain. Additionally, Greece has an agreement with the FSU for line construction to deliver FSU gas to Albania. The 44 mile lateral line will deliver gas from the above Bulgaria - Athens line, branching off at Ptolemias and running to the Greek border.

(b) DEPA has in hand:

- 62 miles of 36in and 257 miles of 30in gas lines from Koula to Athens (contractor; Machinoimport/Biokat); completion end 1994
- 22 mile distribution system for northern Attica. DEPA and PEDRA-Attica gas are involved.

(10) Hungary

(a) In 1994 Hungary expects to use 360 bcf of natural gas, half of which is imported from Russia. Since growing imports make is essential for Hungary to diversify its sources of supply, the country commenced construction of a 90 mile gas pipeline between Gyoer and Baumgarten in eastern Austria in March 1994. With an annual capacity of 160 bcf the pipeline will be the first one to connect Hungary with the West European gas network and is expected to cost $245 million, three-fifths of what is to be borne by the Austrian side Completion is expected in October 1996.

Strong reliance on continuous energy supplies makes the Hungarian economy particularly vulnerable. In 1993 the country imported almost 180 bcf of natural gas

from the former Soviet Union. At the same time, it consumed over 340 bcf of gas. In 1994 Hungary will import 100bcf of natural gas from Orenburg and 70 bcf from Yamburg, through two branches of the Brotherhood pipeline. The total length of Hungary's high-pressure gas network is 3,000 miles. Diversification of energy imports is all the more important because Hungary's gas consumption is expected to sharply increase and, due to cheaper imports, the country's energy programme cannot count on an increase in energy production.

Nevertheless it is reported that planning continues on a 200 mile pipeline to carry FSU gas across Hungary to Yugoslavia. The estimated cost is $132 million with a 1998 completion date (which is dependent, obviously, on a solution to the current hostilities in Serbia/Croatia etc).

(b) Since 1989 local authorities in the underdeveloped regions of the country have invested $100 million in expanding the gas distribution network, and the central budget has contributed a further $30 million. As a result, hundreds of thousands of new consumers have been provided with natural gas, bringing their total number to two million. Up to 1996, local authorities are to invest another $200 million and the central government $50 million in gas pipeline construction, so as to integrate hundreds of thousands of more homes into the network.

(c) The 5 regional gas distribution companies are to be privatised. The companies serve domestic users outside Budapest and an international tender is to be held. The Hungarian government will retain one golden share.

(d) Hungary, Austria, Croatia, the Czech Republic, Slovakia, and Slovenia plan to construct a gas pipeline between Krk, Croatia, and Vienna. The feasibility study for the project is being prepared. The new pipeline will only be used to capacity in case of emergency, as Hungary's long-term energy policy scheme gives priority to buying energy resources from the former Soviet region. In the spirit of this endeavour, both sides have launched talks on prolonging contracts for gas deliveries from Yamburg and Orenburg.

(e) Hungarian Oil and Gas Co Ltd (MOL Ltd) projects in hand are:

- 38 miles, 16in gas line under construction from Szank to Kalocsa. Completion; 1994
- 23.4 mile, 16in gas line from Kalocsa to Szekszard. Completion; 1994
- 42 mile, 28 in gas line from Oh to Gyor. Completion; 1995
- 49 mile, 32in gas line from Hajduszoboszlo to Endrod. Completion; 1996
- 21 mile, 28in line from Szank to Varosfold compressor station. Completion; 1996.

(11) Ireland

(a) Republic of Ireland.

There were decades on conjecture about the right time to build the interconnector between the Republic Ireland and the United Kingdom. The decision was made in 1992 and the first delivery of natural gas from the United Kingdom came in 1994.

The line was laid between north County Dublin to Moffat in Scotland, passing west of the Isle of Man. Of its 147 mile length, 126 miles are subsea. It is 24 inches in diameter. At present the line is delivering gas at 1000 lbs/sq inch and is expected to do so until the turn of the century and has the facility to provide line back up to 1600 lbs/sq inch initially. At a later stage a compressor will be installed in Scotland to increase throughput.

The project was expected to cost $435 million but was completed substantially below budget. The European Union will contribute grant aid of about $137 million to the Republic's cost. One of the largest and most important engineering projects ever undertaken in the state, the interconnector was the work mainly of Irish engineers and technologists. It is owned and operated by Bord Gais Eireann.

(b) Northern Ireland

Gas is to be piped 84 miles from Scotland to Northern Ireland as part of a $450 million investment by British Gas.

If planning permission is granted in a timely way then supplies, could be available by October 1995. This would enable BG to convert a 1,080 MW power station at Balylumford it bought in 1992 from oil to gas-burning. The project will provide initial contracts for two companies with involvement in North Sea oil operations.

European Marine Contractors, a partnership between Brown and Root and Saipem, will lay the 25 mile 24 inch offshore pipeline link from Dumfries and Galloway to the landfall near the power station at Islandmagee, Northern Ireland starting in June 1995. Detailed engineering will be handled by Snamprogetti. Cost is put at $204 million.

Over the same period, McDermott Engineering, part of the group which owns the fabrication yard at Ardersier, near Inverness, will carry out conversion of boilers at Ballylumford.

Regional development support from the European Union is expected for the project.

A multi million pound project is proposed to update a former gas distribution pipeline system in Belfast with the potential to supply half a million people with natural gas. Premier Energy Suppliers, a British Gas subsidiary is at the heart of

the proposals which will involve a new transmission pipeline to be run from Ballylumford power station which will convert to natural gas in late 1996.

(12) Italy

Algeria's Sonatrach has agreed to supply Italy's SNAM SpA a further 72 bcf/year of LNG beginning in 1996. This is part of the state enterprise's plan to hike total exports of natural gas and LNG to 2.160 tcf/year by 2000 to be split 50/50 between the two energy forms.

Italy's gas consumption is about 1.8 tcf/year with the latest contract making it the main importer of Algerian gas.

The Sonatrach natural gas will move through two gas pipelines: the Transmed line, where capacity is being doubled through additional compression installation, and the Maghreb line, due for completion in early 1996. The expansion of the Transmed line - which, runs from its Sicily terminal to storage facilities in north Italy - is in the hands of a consortium of Total, OMV, INA (Croatia), Petrol Zemeljski (Slovenia), MOL (Hungary), CPP (Czech) and SPP (Slovak)

This will boost Italian imports through the line to 936 bcf/year when it is completed in 1996. Imports through Transmed amount to 450 bcf/year at present.

Additionally, it is reported that AGIP plans to further tap the huge gas reserves of the Algerian Sahara and offshore Libya. It is planned to pipe the gas to Italy via Tunisia once agreement is reached. There is in some quarters speculation regarding the long term political stability of Algeria (as mentioned elsewhere in this Review).

(13) Macedonia

Makpetrol plans a 62 mile gas line from Kriva Palanka (Russia), near the Bulgarian border to the Macedonian capital of Skopje; cost estimate, $60 million; completion, 1995. The line could be further extended to Albania.

(14) The Netherlands

(a) Gasunie projects in hand are:

- 26 miles of 48in pipe from Grijpskerk to Garrelsweer; under study; completion October 1996
- 3 miles of 48 in pipe from Oudbosch to Woezik; functional design stage; completion October 1995
- 14 miles of 18 in pipe from Zegge to Moerdyk.
- 18 miles of 32in pipe from Alkmaar to Oudesluis

(b) Unocal Transportation has contracted to John Brown/Zectech for engineering services for the 40 miles 12in offshore gas pipeline system from the Horizon platform to the Helder platform; completion, spring 1995.

(15) Norway

On 29th April 1994 the 503 mile offshore Zeepipe was officially inaugurated. The pipe project and the transit agreements entered into between the Troll gasfield sellers and Belgium's Distrigaz opened a new route for Norwegian gas to the French, Spanish and Belgian gas markets; it also marked a turning point in the history of Norway as a gas nation, in that the Zeepipe, just one element of the Norwegian infrastructure to the Continent, marks the beginning of Sleipner/Troll gas contracts.

At the beginning of the next century, the new Troll/Sleipner export contracts will have effectively doubled Norway's gas exports to the Continent. As export volumes under the Troll agreement will reach 1.61 tcf by the year 2005, Norway's total export commitments, including the depletion contracts signed in 1977 for the Ekofisk and Frigg fields and in 1985 for the Statfjord, Gullfaks and Heimdal fields, will be over 1.80 tcf at the beginning of the 21st century.

Indeed, based on a sensible use of existing infrastructure, gas reserves and expected market developments, annual sales of Norwegian gas may increase even further to a level of around 2.5 tcf some years into the next century.

Believed to be the largest industrial agreement ever signed, the Troll gas agreement signed in 1986 with Germany, France, Belgium, the Netherlands, Spain and Austria, for Norway to supply 36 tcf of gas over the next 28 years, has made Norway into a major European energy power. However, what confirmed Norway's position was its ability to lift these huge development and construction projects off the ground.

This implied that the Norwegian Gas Sellers (GFU) had to commit themselves to investing more than $18 billion for contracts that extend beyond 2022. Phase one of the project consisting of the Sleipner field developments and the Zeepipe line to Zeebrugge is now complete. Phase two will be ready in 1995/96 and will include the Europipe trunkline and the Troll gas platform. Phase three could be ready at the beginning of next century and will include new field developments and new pipeline infrastructure. (See later under the North Sea for more project information).

(16) Poland

(a) Poland has announced cautious new privatisation plans, which would allow Warsaw to keep control of the country's pipeline and rail petrol distribution system.

(b) The proposed 146 mile gas transmission system from Poland's Niechorze to deliver Western European gas to the country still appears to be on hold. Europolgaz, a Russia/Polish venture is thought to be involved.

(c) Negotiations continue between the Polish Minister of Industry and Trade, the Russian Ministry for Foreign Economic Relations and Russia's biggest natural gas exporter Gazprom, about the construction of a new gas pipeline from the Russian town of Torzhok through Poland, into Germany and further west. Under the terms of the agreement being negotiated Poland would receive an extra 500 bcf of gas a year until the year 2010 in addition to transit fees. The cost of the project, excluding storage tanks, is estimated as $3 billion. Capacity of the pipeline will be 2.5 tcf. But even the extra supplies of Russian gas, over and above the current supplies of not quite 250 bcf a year, will not satisfy Poland's total needs for gas, and the possibility of getting supplies of North Sea gas is still being considered. According to Polish sources by the year 201 0, if the economy develops as it should, Poland's gas requirement will be 1.26 tcf a year which will then account for 25% of the country's total energy needs.

(17) Portugal

(a) The Portuguese government has issued is approval for the Transgas consortium to build a $686 million large-diameter natural gas pipeline that will connect with regional distribution systems (see below).

Transgas is composed of Gas de Portugal, Caixa Geral de Depositos, Electricidade de Portugal (EDP) and three regional gas distribution utilities.

Plans call for the group to build 250 mile transmission system that extends north from Setubal near Lisbon to Braga and east to the Spanish border, where it will connect with the Maghreb-Spain line in 1996.

While the government wants the system in Portuguese control, the consortium is looking for foreign partners. Companies showing an interest include British Gas, Ruhrgas and Enagas.

(b) Regional distribution companies - Portgas, Lusitaniagas, Setgas and Gas de Portugal - are moving forward with plans for local networks that will be supplied by the new transmission system.

Four companies have been awarded contracts for the 397 mile gas distribution network. Mannesmann Anlagenbau, Suedrohrbau, GTM - Entrepose and Spie-Capag. Pipe Line Engineering will be responsible for technical management, while Europipe will supply the pipe and AEG the control systems.

The distribution companies have signed contracts for the supply of gas to the northern and central sections of the country and north and south of the Lisbon area. This will make them eligible for EU grants to pay the costs of developing their low pressure networks.

(18) Spain

(a) Basque energy authority EVE, owner of Gas de Euskadi (G deE), has proposed linking the region's two gas transport and distribution grids.

EVE has also invited national hydrocarbons group INH to join a $125 million project to build a pipeline to the French gas grid through Bidart and an 18 billion therm/year regasification plant at Bilbao port.

The Basque primary and secondary gasline networks are currently shared by GdE (66% owned by EVE and 34% by full INH subsidiary Enagas) and Enagas itself. GdE controls 75% of the network and Enagas 25%.

Essentially, the proposal is a rationalisation move to boost efficiency and cut costs, since both GdE and Enagas operate separate networks in the Basque country.

(b) ENAGAS projects in hand are:

- Construction of a new gas pipeline to distribute natural gas for industrial use in the Toledo area; contractor, Obramin (a joint venture of Obrascon and Amingapesa)
- 256 mile gas line from Valencia to Alicante; contractor, Technicas Reunidas/Heymo Ingeniera; completion, end 1994
- 107 miles of 8-12in gas line from Cordoba to Jaen-Granada in engineering stage; contractor, Technicas Reuidas/Heymo Ingeniera; completion December 1995
- 242 miles of 20in line and 40 miles of 26in line in Galicia in engineering stage; contractor, INITEC/Intecsa; completion, July 1997
- Two gas lines, associated with the Maghreb project (see separate entry): one in the north linking La Coruna and Asturias, the other in the south linking Cadiz and Cordoba. Cost estimate, $296 million.

(c) Empresa Nacional de Gas SA projects in hand are:

- 66 miles of 4-14in line from Oviedo to Tuy in the engineering stage. Distribution lines for Ferrol, Coruna and Santiago de Compostela; contractor, INITEC
- 112 miles of 20in line from Oviedo to Tuy in the engineering stage; contractor, INITEC
- 40 miles of 26in line from Ferrol to Villalba (Lugo) in the engineering stage; contractor, INITEC.

(d) REPSOL projects in hand are:

- 218 miles of 10in gas and products line from Cartagena to Puertollano in the detail design stage; engineering/construction contractor, INITEC; completion, April 1996

- 70 miles of 8in pipe (cost $12 million) in the Bay of Biscay Albatross gas field to link to the Gaviota field platform via a 450 yard flexible riser; contractor, Aberdeen (Scotland) - based Sten Offshore, engineering - through - installation; completion, end 1994.

(19) Switzerland

Gazverbund Ostehewuiz AG projects in hand are:

- 29 miles of 20in line from Ohringhen (Winterthur) to Bischofszell; completion, 1995
- 2 miles of 10in line from Mettlen to Weinfelden; completion, 1995.

(20) Turkey

Botas is studying a 1,118 mile 12in gas transmission network.

(21) United Kingdom

(a) Kinetica, the independent gas supplier owned by Conoco and PowerGen is sounding out support for a possible $600 million investment programme to construct a 48in pipeline from St Fergus in Scotland to Bacton on the East Anglian coast. In the meantime, the company has in hand:

- 158 miles of 36in pipeline proposed to the Isle of Grain on the Thames from Theddlethorpe; cost estimate, $300 million; completion, during 1995
- 30 miles of 20in line under construction from Theddlethorpe to the PowerGen power plant at Killingholme.

(b) British Gas is to close is Engineering Research Station (ERS) at Killingworth, Newcastle. Much of the work is for offshore applications and 400 highly qualified jobs may be lost.

(22) The North Sea

As in the 1994 Survey, this separate section reports on developments and the status of projects underway or planned.

Present Position

Tax changes have been held responsible for reduced exploration activity on the UK Continental Shelf in 1993, although a low oil price must have had an effect. However, appraisal wells stood up well, on a par with 1992, while development wells at 134 continued the upward trend since the 108 figure of 1990. A government survey, conducted in 1994, reveals that operators expected to drill some 16% less wells in 1994 than actual wells drilled in 1993 but they will drill slightly more in 1995. This will lead

to an increase in capital expenditure levels over 1994 as reflected in higher activity levels for associated trunk pipelines, loading systems etc.

The government has announced the 15th North Sea oil and gas licensing round. It is anticipated that many companies will accelerate their programmes to ensure that discoveries can be tied into the existing transportation infrastructure.

As many as 90 new fields could be developed in the North Sea over the next two decades, according to Grampian Regional Council's annual review of oil and gas prospects. This authoritative report has once again predicted a positive long-term future for the North Sea, with significant production expected well into the next century.

Phillips Petroleum is to change the route of the planned pipeline between the new Judy-Joanne development and Norpipe in order to keep the pipe within British waters. The decision is in response to tensions between Norway and Britain over the Frigg Treaty.

In mid-1994 it was announced that Amoco Exploration had been awarded several contracts to develop two new natural gas fields in the U.K. North Sea. Work includes the construction of two platforms at the Davy and Bessemer fields 60 miles off Norfolk and a pipeline to connect them. Brown and Root Highland Fabricators, a U.K. company, will build the platforms. British Steel has won the contract to supply a pipeline to carry the 210 mcf capacity of both fields to a platform in the Indefatigable field. Also, Allseas Marine Contractors S.A. will provide another smaller pipeline for completion before end 1994. The company will use an existing pipeline to transport the gas to the company's processing terminal at Bacton, Norfolk. Similarly, development of the Caister and Murdoch Fields requires a 112 mile 26in line, probably to Theddlethorpe.

Amoco (UK) Exploration says it will link the Central Area Transmission System (CATS) pipeline from the North Sea to Britain's gas grid. The tie-in will reach 4 mile with 36in line from the Seal Sands terminal at Teeside to Cowpen Bayley.

Projects

Bacton - Zeebrugge Interconnector

Britain's gas industry has decided to support an ambitious $660 million project a build a 150 mile 40in gas interconnector from Bacton, Norfolk to Zeebrugge, Belgium. In mid-December 1994 nine potential users converted their enthusiasm into solid commitment. This allows construction to start in 1996 and operations in 2000.

The driving force behind the plans is the tantalising prospect of exploiting shortfalls in the European gas market. As much as 40% of this shortfall could be met by the United Kingdom and Norway.

A major uncertainty factor in the decision - making process was an impending competitive decision concerning a dedicated pipeline to Europe from the huge Britannia gas field. (See below for more information).

The Interconnector's trump card is its flexibility. Although it will begin life as an export line, it is of course capable of reverse flow and in 15, 20, perhaps even 25 years from now, Britain will need to begin importing gas. A direct line means that the gas is lost forever from the UK whereas with an Interconnector you can allow price and the market to determine where the product actually ends up.

With the future of the market so uncertain, the sponsors believe their project can play a key role in stabilising prices. By matching supply and demand, the Interconnector will smooth out the peaks and troughs and keep UK gas prices in line with the rest of the Continent.

By promising increased competition and restrained prices, the Interconnector also wins the whole-hearted support of the UK government.

For the record, the Interconnector Study Group was set up in 1992 by British Petroleum Co plc, British Gas plc, E.I. Du Pont de Nemours' unit Conoco Ltd, Elf Aquitaine, Norsk Hydro A/S, Den Norskje Stats Oljeselskap A/S (Statoil) and Distrigaz of Belgium. The Group has first increased the planned size of the pipeline to 38 inches and then accepted a further increase to 40 inches. The Group, back in March 1994, awarded five contracts for conceptual engineering. Conceptual work on the Belgian terminal at Zeebrugge will be done by Tractabel, with British Gas designing the UK terminal at Bacton. A consortium headed by EMC will work on the offshore pipeline with Geoteam conducting the offshore survey. Haecon was awarded a contract for conceptual engineering on the onshore section in Belgium.

It is clear that this latest development is a positive move which will bring a proper international market in gas a step closer. The flow will be from here to there and the link will allow producers more freedom from the monopoly buyers which dominate continental countries.

At present, there is effectively a bar on shipping gas, but this makes no economic sense and is increasingly against British interests. Gas development is all the rage in the North Sea, and a surplus is forecast even after supplying the new generation of power stations. The pipeline will be capable of handling two billion cubic feet a day, or a third of current UK demand.

The presence of Russia's Gazprom, the world's biggest gas company, among the nine companies shows how a two-way trade could develop. Gazprom will be able to buy in the British market to cope with demand it is unable to satisfy in France and Germany.

Other participants are British Gas (which has provisionally booked almost a third of the line's capacity), Amerada Hess, BP, Conoco, Distrigaz of Belgium, Elf and Ruhrgas, with National Power the surprise member. No Statoil or Norsk Hydro.

One day, Britain's gas reserves may start to dwindle - although forecasts of the fall-off in North Sea oil production have been hopelessly pessimistic - and gas could start to flow back to Britain. But it will be well into the next century before British houses cook on Siberian gas.

Britannia

Partners in the giant UK Britannia gas/condensate project are considering four options for pipeline routes before deciding where the gas will go and where a new onshore terminal might be built. The group led by joint field operators Chevron and Conoco is also mulling over two alternative plans for condensate transportation.

The gas pipeline options officially include one route to St Fergus in Scotland (although in fact that has effectively been discarded) and another to Teesside in England, and two others to sites on the European mainland - Eemshaven in The Netherlands, which appears still to be finding favour, and a fourth at an as yet undisclosed location on the coast of Denmark (and linked to the fanciful Polpipe scheme to take gas to Poland), an idea which also already seems to be largely out of the running. Both plans for condensate involve landing product in Scotland. Condensate would be separated on the Britannia complex and sent either via Elf Enterprise's Piper complex and subsea pipeline to Flotta in the Orkneys, or via BP's Forties field and pipeline to Cruden Bay between St Fergus and Aberdeen, or shipped to either destination by shuttle tanker. Chevron/Conoco says the decision on siting terminals and picking pipelines will ultimately be determined by who buys the gas.

Key issues on that front will include whether some Britannia gas is sold directly to continental customers such as German Ruhrgas or Wingas, the marketing operation backed by Russia's Gazprom and Germany's Wintershall. That, in turn, depends on whether Britannia will have to use the Interconnector pipeline project supported by UK government (see above). No deadline has yet been indicated for deciding pipeline routing for either gas or condensate from Britannia. On the contrary, Chevron, Conoco and company seem prepared to play a waiting game with potential customers.

However, at end -1994 it was announced that the project was to go ahead.

Norway - Europe Pipelines

Norwegian State oil company Statoil targeted to pursue pipelay work worth some $600 million on gas trunklines in the 1994 pipelay season.

This included $360 million to complete the Europipe gasline to Germany, due operational on 1 October 1995 and $242 million on the first 93 miles of Zeepipe Phase IIA between the Sleipner East field and a new gas terminal at Kollsnes, near Bergen, Norway. This is due operational on 1 April 1996.

Statoil is considering extending its pipeline network into continental Europe with construction of a fifth line to supplement the four (Statpipe, Zeepipe, Europipe and Norpipe) already operating or under development.

To meet future commitments, Statoil needs to increase pipeline capacity by around 540 bcf/year (1479 mcfd) of which it estimates 45% will be needed for buyers in eastern parts of Europe by 1999 and for western buyers by 1998.

Landfall options include Zeebrugge in Belgium, Emden in Germany and the Dunkirk region in France. Norwegian sources have suggested that Belgium and Germany offered some advantages, one of which was the shorter geographical distance from Norway to these countries.

The landing point and terminal in Belgium already exists as the recently opened Zeepipe comes ashore at Zeebrugge. Europipe, currently under construction, will land at Emden and Statoil already has permission to run a second pipeline in the tunnel being excavated under the environmentally-sensitive Wattenmeer national park. However, the fact that Statoil already had pipelines running to Germany and Belgium certainly made a French landing point attractive in terms of flexibility and diversity.

The commercial and economic considerations of each option continue to be evaluated with decision time geared towards end-1994. It is clear that Statoil needs one additional pipeline also compression on one existing pipeline such as Zeepipe to satisfy extra transport capacity for both eastern and western markets. Landing in the Netherlands had been discounted as this country's position in the centre of Europe means punitive transit charges would be incurred for both western and eastern routes.

Technically, a new line would not necessarily mean a pipeline running all the way from the Norwegian Sea to Germany; it might be a pipeline from Germany to a connection point between Ekofisk and Emden, or up to Kollsnes. Similarly, compression on Zeepipe might involve looping all or part of the line, depending on demand for capacity.

Regarding France, Statoil will have learned lessons from Europipe and Zeepipe to exist with assessments, if a French landing point was to be chosen for a fifth line. However, the character of the industrial area around Dunkirk does not present such an environmental challenge as that found in the national parks along the German coast at Emden. In addition, the power of local government authorities in Germany made the process of consultation at both regional and national level very time-consuming, while the centralist government in France offered more of a one-stop consultation process.

Crucially, what needs to be understood is that compared to a year ago Zeepipe plans have changed. This represents the Zeepipe consortium's decision to get a jump on the market prior to Russian Yamal gas becoming available. Initially, Zeepipe phase 2 was to export gas by way of Sleipner/Heimdal area in the North Sea. The current proposal calls for a line from Kollsnes, Norway to Emden, Germany. It will link with a line laid parallel to Europipe through the landfall section to Emden. Projections indicate a $220 million saving compared to the original route. Operations are scheduled for October 1997. In conjunction with the plan, there is a proposed onshore transmission line to deliver the North Sea gas to France by 1998 (as mentioned earlier).

The new route is not without controversy. The Kollsnes to Emden line will transport only Trollfield gas and doesn't provide service for other Norwegian fields. To meet

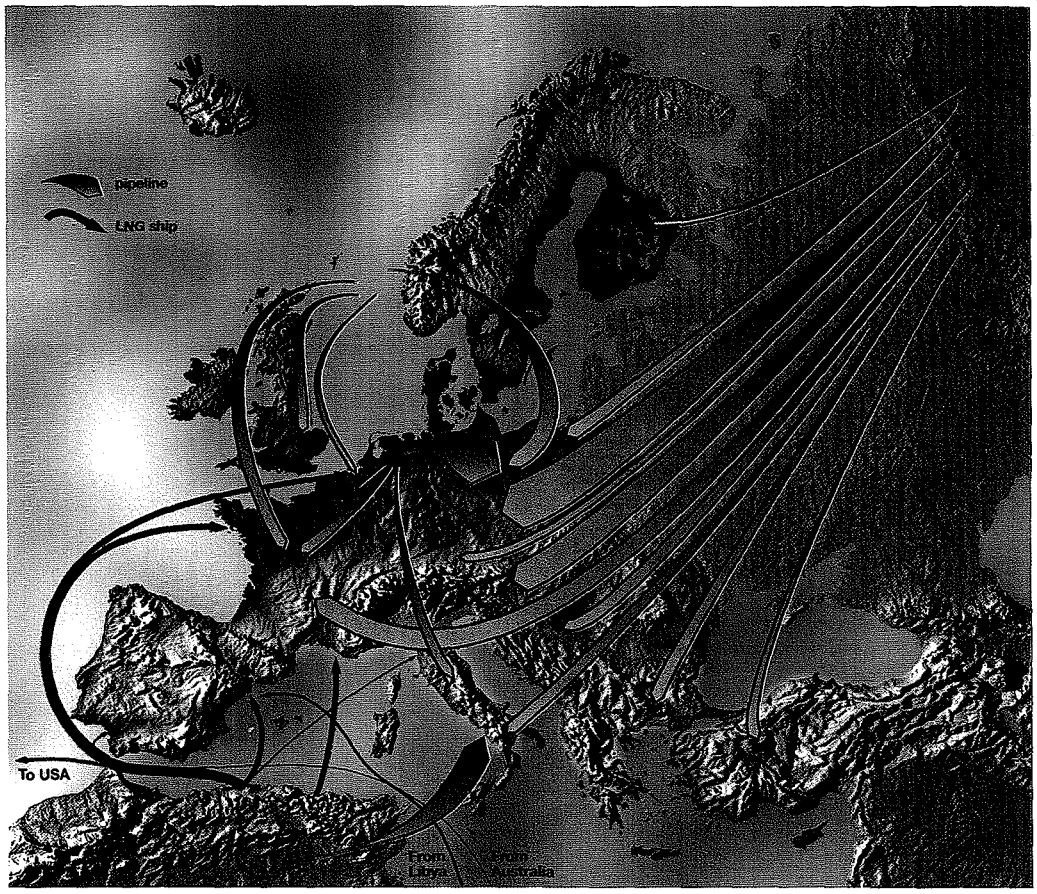
those needs, another line has to be considered to the Sleipner/Heimdal area, reaching Zeebrugge or Calais by 1998.

For the record, progress on other North sea related projects underway or planned is as follows:

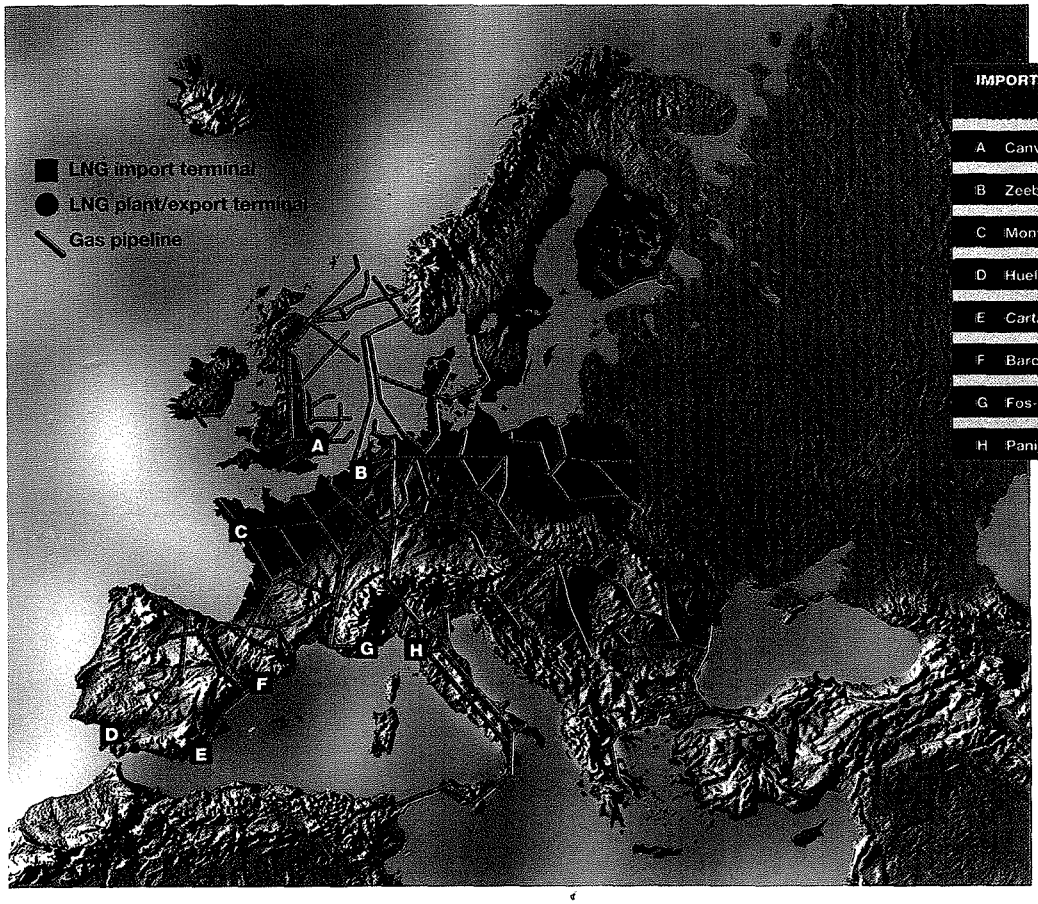
- Den Norske stats Oljeselskap a.s. is serving as operator for the Zeepipe group also building the 372 mile, 40in Europipe project. Construction is advanced on the system reaching from riser 16/11-5 to a point between Germany's Emden and Etzel. For the most part, the line will parallel the existing Norpipe gas system to Emden. Like Zeepipe, the system is designed for capacity increase by adding horsepower.

- Haltenpipe natural gas system will reach 152 miles, 16in from the Heidrum field to Teldbergodden, where the gas will be used as feedstock for methanol production. Pipelaying is scheduled to start by end 1994 with commissioning by the end of 1996.

- NETRA is a joint venture between Statoil, Norsk Hydro, Ruhrgas and BED Erdoel and Erdgas. It plans a 174 mile pipeline from Etzel (see Europipe above) to Salzwedel on the eastern German border.



Major pipelines and LNG terminals



	IMPORTERS	CAPACITY (million m³ NG/day)
A	Canvey Island, UK	4.50
B	Zeebrugge, Belgium	17.80
C	Montoir-de-Bretagne, France	31.00
D	Huelva, Spain	6.30
E	Cartagena, Spain	2.10
F	Barcelona, Spain	29.00
G	Fos-sur-Mer, France	22.00
H	Panigaglia, Italy	11.00

Imports by pipeline 1993

(bcm)

EXPORTER													IMPORTER
USA	Canada	Bolivia	Mexico	Denmark	Germany	N'lands	Norway	UK	FSU	Iran	Algeria	Malaysia	Total Imports
					0.10				5.30				Austria 5.40
						4.12	3.69						Belgium 7.81
									4.80				Bulgaria 4.80
									13.30				Czech R. & Slovakia 13.30
									3.10				Finland 3.10
									2.30		0.28		Former Yugoslavia 2.58
						5.00	5.58		11.60				France 22.18
				0.76		27.21	8.47	0.14	25.70				Germany 62.28
									5.30				Hungary 5.30
						5.40			13.70		13.60		Italy 32.70
						0.67							Luxembourg 0.67
							2.67	0.14					Netherlands 2.81
									5.90				Poland 5.90
									4.60				Romania 4.60
							0.20						Spain 0.20
				0.85									Sweden 0.85
					1.40	0.70			0.30				Switzerland 2.40
									5.00				Turkey 5.00
							4.03						United Kingdom 4.03
				1.61	1.50	43.10	24.64	0.28	100.90		13.88		

Imports by ship 1993

(bcm)

EXPORTER								IMPORTER
USA	UAE	Algeria	Libya	Australia	Brunei	Indonesia	Malaysia	Total Imports
		4.30						Belgium 4.30
		9.00						France 9.00
		0.29						Italy 0.29
		4.34	1.60	0.04				Spain 5.98
		17.93	1.60	0.04				

Length of transport pipelines system in Europe (1)

(1000 km)

COUNTRY	1965	1970	1980	1985	1990
WESTERN EUROPE	**48.1**	**75.3**	**126.4**	**153.0**	**175.8**
Austria	1.2	1.4	2.8	3.1	3.6
Belgium	1.1	2.1	3.2	3.2	3.3
Denmark	-	-	-	0.8	1.0
Finland	-	-	0.2	0.5	0.8
France	13.5	15.8	23.6	26.6	30.1
Germany (2)	20.7	32.3	51.7	66.9	77.2
Ireland	-	-	-	-	0.6
Italy	5.4	8.5	15.1	19.0	23.1
Luxemburg	-	-	0.6	0.7	0.8
Netherlands	4.4	8.4	9.5	10.0	10.5
Norway	-	-	0.8	1.1	1.6
Spain	-	-	1.2	1.8	2.5
Sweden	-	-	0.3	0.3	0.3
Switzerland	0.8	1.2	2.2	2.6	3.0
United Kingdom	0.5	2.5	12.1	13.0	13.5
Yugoslavia	0.5	3.1	3.1	3.4	3.9
EASTERN EUROPE	**13.3**	**17.8**	**29.7**	**37.4**	**42.7**
Czechoslovakia	4.2	6.2	9.9	12.6	14.0
Hungary	0.3	0.6	1.6	4.2	4.3
Poland	3.8	5.0	10.5	12.1	14.4
Romania	5.0	6.0	7.7	8.5	10.0
TOTAL EUROPE	**61.4**	**93.1**	**156.1**	**190.4**	**218.5**
FORMER SOVIET UNION	**37.1**	**63.2**	**131.6**	**174.5**	**220.0**

(1) Excluding distribution pipelines

(2) Unified Germany

International transport pipelines in Europe - Operational

Gas origin	Destination	Gas pipeline	Start-up date	Length (km)	Diameter (inches)	Nominal capacity (10^9 m^3/year)	Companies
Former Soviet Union	Western Europe	Transgas	December 1972	3736 (1)	48, 36 and 32	75	Transgas (Czech and Slovak Republics)
	Austria-Italy	TAG I and II	February 1974	1411 (2)	38, 36, 34 and 42	17	OeMV
	Austria/Yugoslavia	SOL	1978	27	20	3	OeMV
	Austria/Germany-France	WAG	May 1980	245	32	5	OeMV/Gaz de France/Ruhrgas
	Germany-France	MEGAL	1.1.1980	1070 (3)	36 and 48	22	Ruhrgas/ Gaz de France/OeMV
	Germany	Sayda-West Berlin	October 1985	235	24		
	Germany	STEGAL	October 1992	316	32 and 36	8	Wintershall/ Gazprom
Netherlands	Germany-Switzerland-Italy	TENP-Transitgas	1974	830	38, 36 and 34	7	Ruhrgas/ Swissgas/SNAM
	Belgium-France	Poppel-Blaregnies	1966	164	36	12.7	Distrigaz/ Gaz de France
Norway	United Kingdom	Frigg	August 1978	350	32	12	Frigg Group
	Western Europe	Norpipe/ Statpipe	September 1977 May 1986	443 882	36, 30 and 28	19	Norpipe A/S Statpipe Group
Algeria	Italy-Slovenia	TransMed	August 1983	2500	48, 40 and 20	16	TMPC/TTPC/SNAM

Total length: 12209 km of which 1750 km offshore

(1) Total of 4 lines
(2) Total TAG I and II
(3) Total of 2 lines

International transport pipelines in Europe - Planned

Gas origin	Destination	Gas pipeline	Start-up date	Length (km)	Diameter (inches)	Nominal capacity (10^9 m^3/year)	Companies
Norway	Western Europe	Zeepipe (Phase 1) (Phase 2)	October 1993 1996	1150	40	12	Zeepipe Group
	Germany-Austria-Netherlands	Europipe	October 1995	630	40	12	Europipe Group
Algeria	Italy	TransMed (extension)	1995	2000	48 and 26	24 (1)	TMPC/TTPC/ SNAM
	Morocco-Spain	Maghreb-Europe	1995	1285	48	8	Sonatrach/SNPP/Ena-gas/GdF/Ruhrgas/GdP
North Sea	Germany	MIDAL	Autumn 1993	600	32, 36 and 40	8	Wintershall/ Gazprom
United Kingdom	Belgium-France-Germany	UK-Continent Gas Interconnector	1997	215 (subsea)	36	15 (2)	Newco (British Gas,BP, Conoco, Distrigaz, Elf, Norsk Hydro, Statoil)
Northern Ireland	United Kingdom (Scotland)	Loch Shinny-Moffat	Autumn 1993	225	24		Bord Gais Eireann
Former Soviet Union	Greece		1994	520		2.5	DEPA

Total length: 6625 km of which 2335 km offshore

(1) Total capacity after extension (ultimate capacity: 30 10^9 m^3/year)
(2) Ultimate capacity

International transport pipelines in Europe - Possible

Gas origin	Destination	Gas pipeline	Start-up date	Length (km)	Diameter (inches)	Nominal capacity (10^9 m^3/year)	Comments
Russia							The first line will cross Russia, Belarus, enter Poland at Brest and connect with the German network.
Yamal	Eastern and	2 lines	2010	> 4000	60	41	
Urengoy	Western Europe	1 line	2000	> 4000	60	26	
Barents Sea		2 lines	After 2000		40	2 x 15	The lines would land at Murmansk and run to Germany.
Turkmenistan	Europe	2 parallel lines	1997-2003	4800	56	40	Total cost of the project is estimated at US$14.3 billion. 24 compressor stations would be installed.
Iran	Europe	Iran Gas Europe project	After 2000	4000		30	The line could run through Greece, the Ionian Sea and to Italy.
Algeria	Portugal-France and other Western European countries	Spain/Portugal Spain/France	After 2000	1035 to the French border	36 to 44	16	Ultimate capacity after full extension; 16 10^9 m^3/year.
Norway	Poland	Polpipe		1200		10	Route: through Denmark to Niechorze in Poland.
	Sweden, Finland, Denmark	TransScandinavian gas pipeline		650		5 - 7.5	Dormant project.
United Kingdom	Poland	Polpipe		1200		5 - 10	Route: through Denmark to Niechorze in Poland.

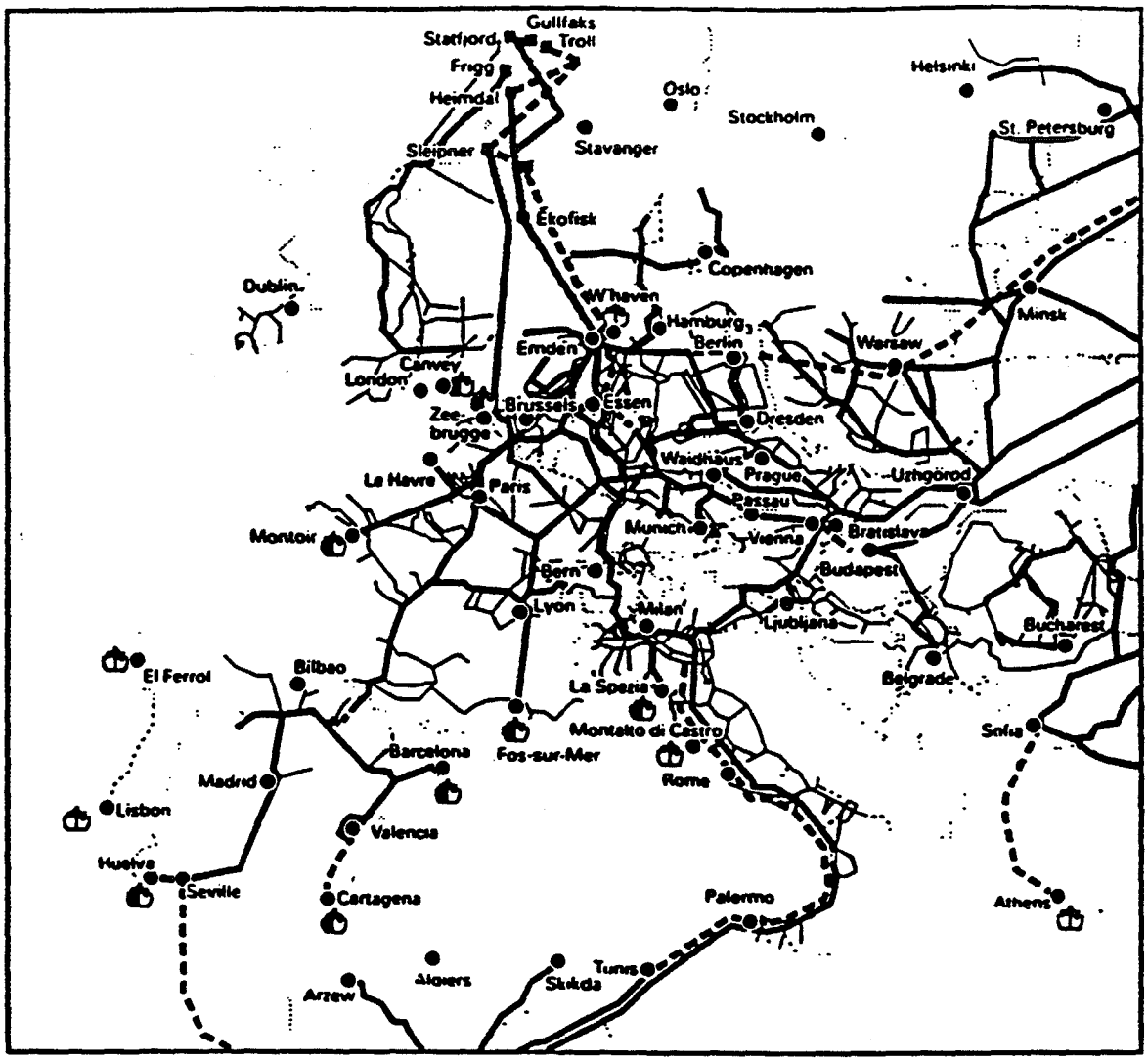
Total approximative length: 31 000 km

European gas network interconnections

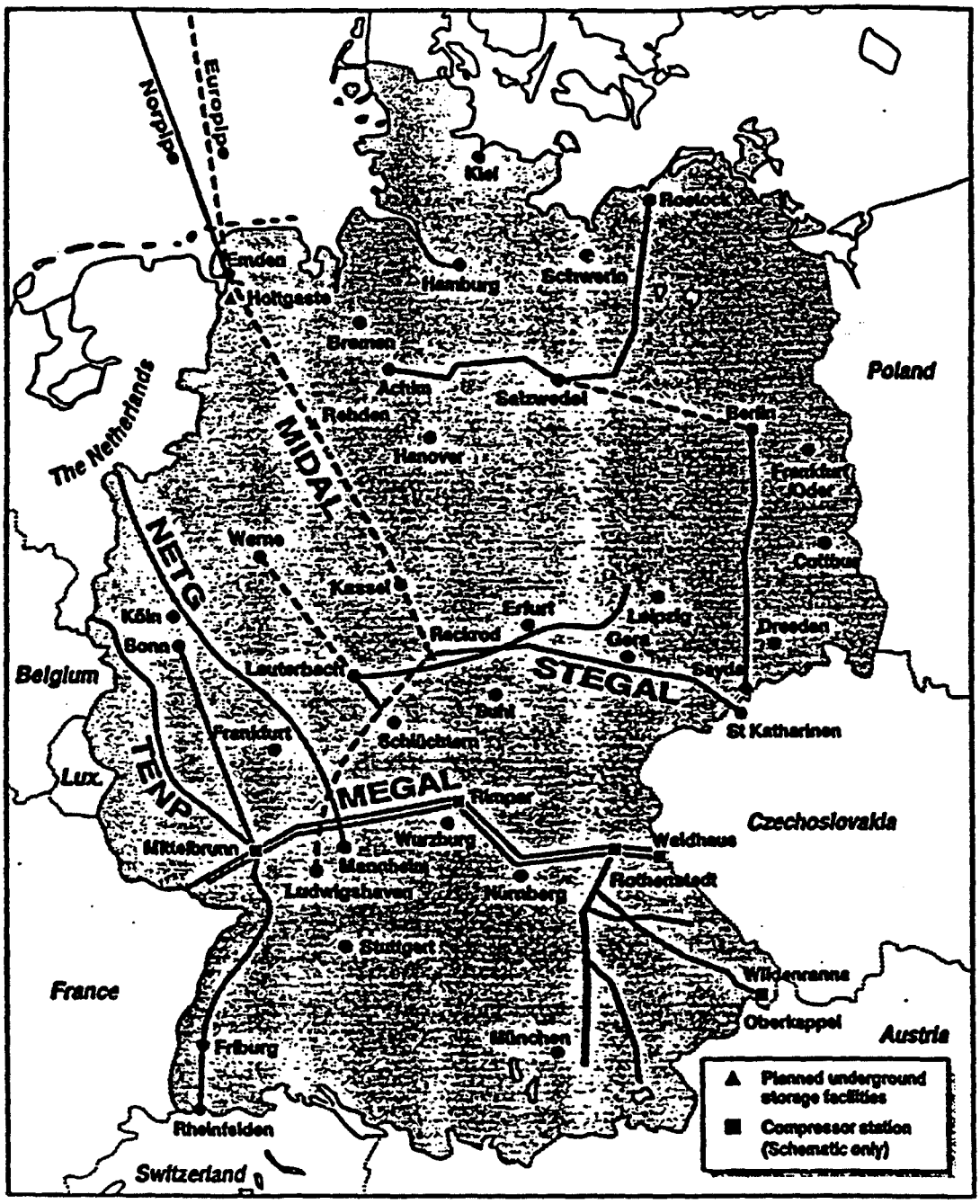
	Algeria	Austria	Belgium	Bulgaria	C.I.S	Czecho-slovakia	Denmark	Finland	France	Germany	Greece	Hungary	Italy	Ireland	Luxem-burg	Morocco	Nether-lands	Norway	Poland	Romania	Spain	Sweden	Switzer-land	Tunisia	United Kingdom	Yugos-lavia
Algeria													X			■					■			X		X
Austria					X	X			X	X		■	X					■								X
Belgium									X	■					X		X	■			■				■	
Bulgaria					X						X									X						
C.I.S		X		X		X		X	X	X	■	X	X						X	X			X			X
Czecho-slovakia		X			X				X	X																
Denmark										X												X			■	
Finland					X																					
France		X	X		X	X				X							X	X			■		X			
Germany		X	■		X	X	X		X								X	X	X				X			
Greece				X	■															X						
Hungary		■			X																					X
Italy	X	X			X	X				X							X						X	X		X
Ireland																									■	
Luxemburg			X															X								
Morocco	■																				■					
Netherlands			X						X	X			X					X					X			
Norway		■	X						X	X					X		X				■				X	
Poland					X	X				X																
Romania				X	X						X															
Spain									■							■		■								
Sweden							■																			
Switzerland					X				X	X			X				X									
Tunisia	X												X													X
United Kingdom			■											■				X								
Yugoslavia	X	X			X							X	X											X		

X Existing connection ■ Planned connection

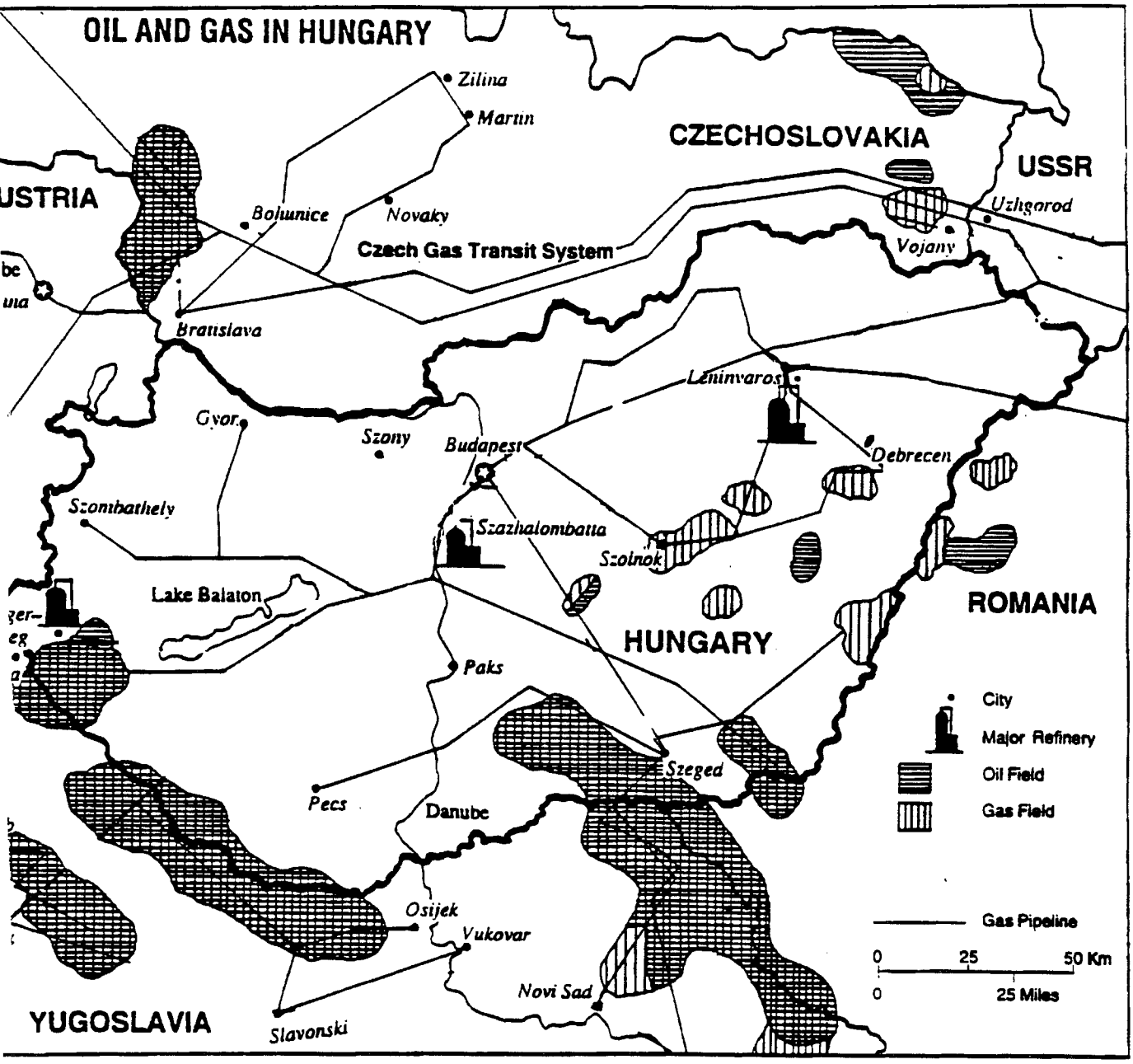
European Natural Gas Grid



ALGERIAN GAS EXPORT PIPELINES

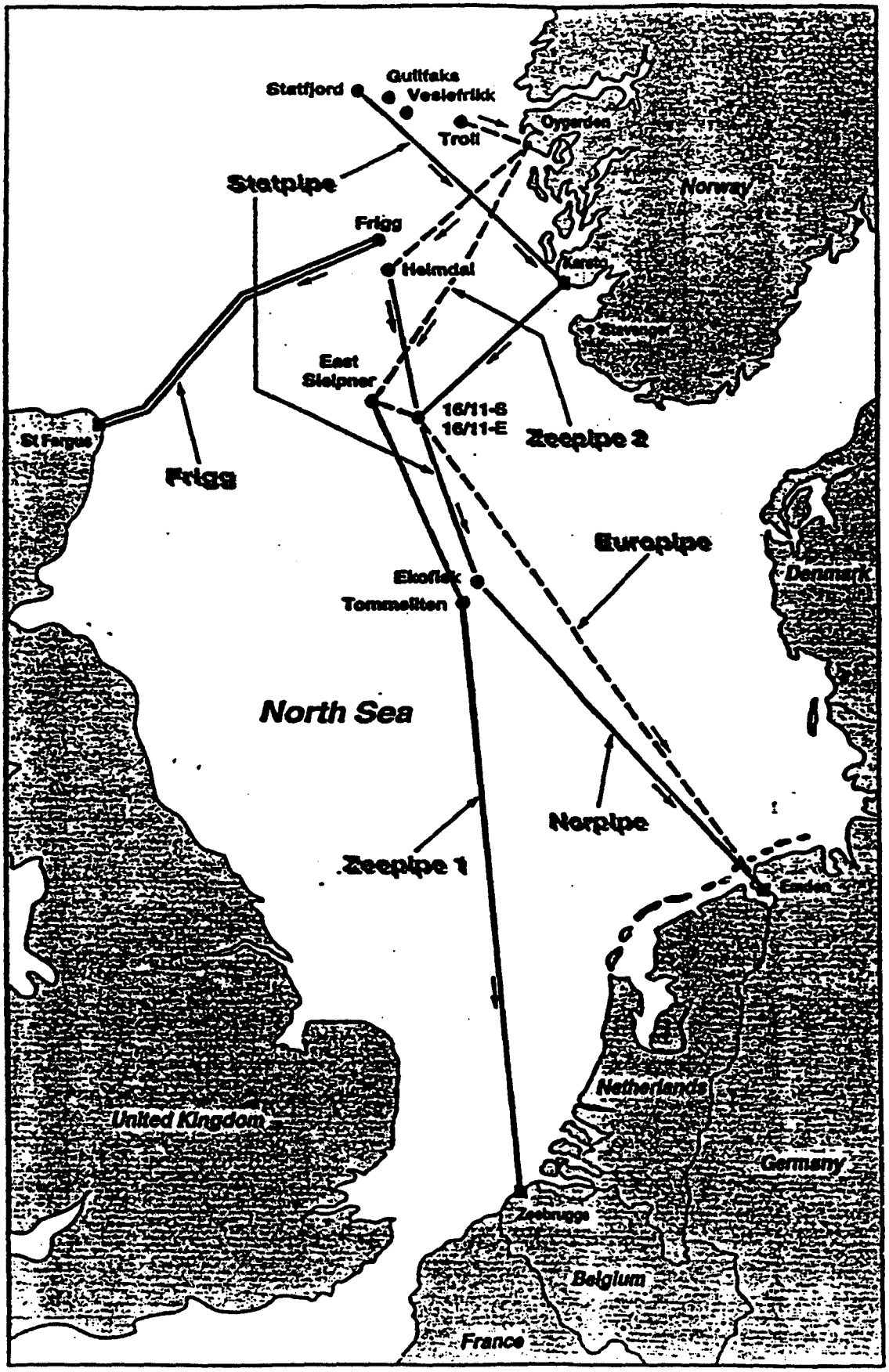


MAIN NATURAL GAS TRANSMISSION SYSTEM IN GERMANY

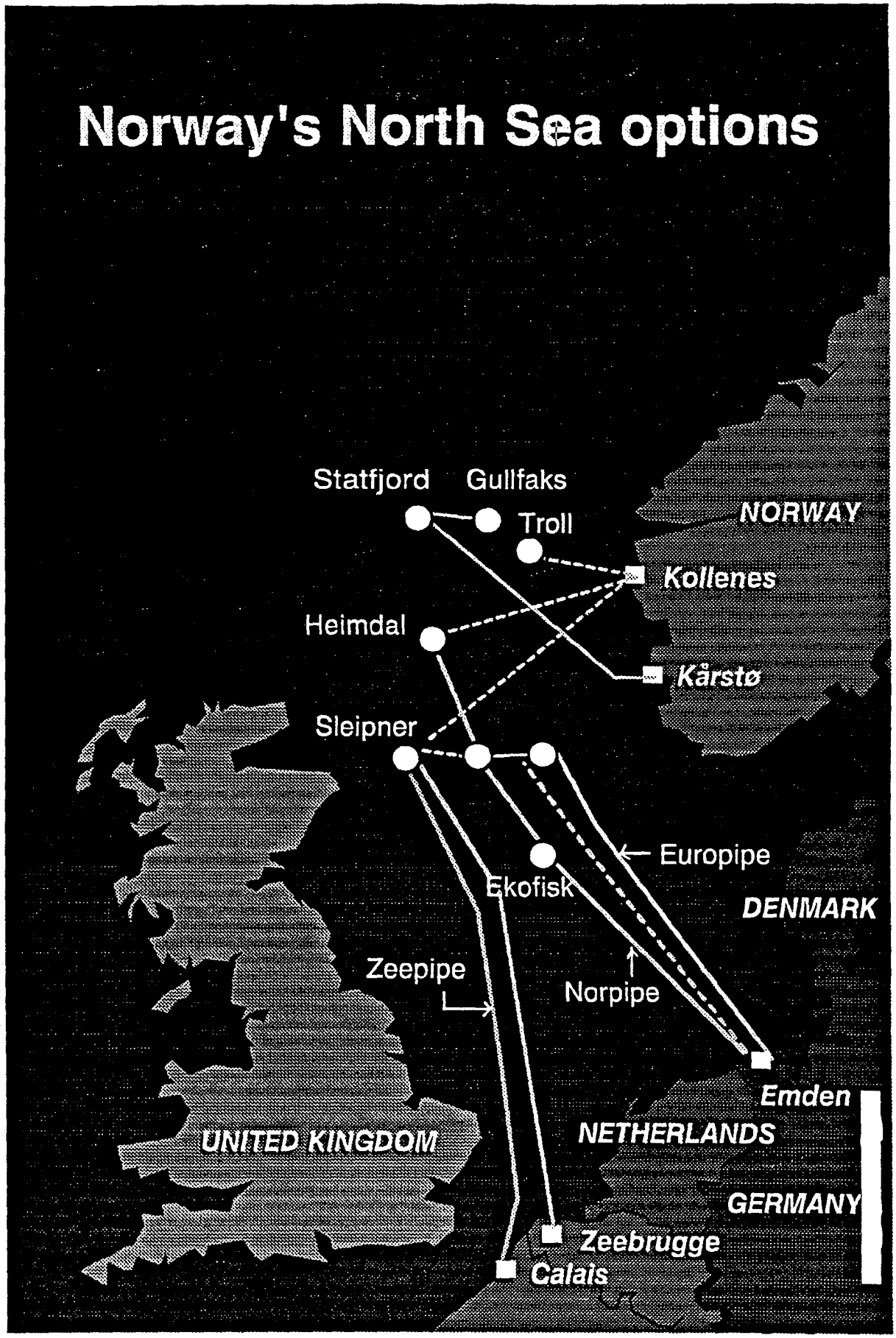

OIL AND GAS IN HUNGARY
Zilina
Martin
CZECHOSLOVAKIA
USSR
USTRIA
Bohunice
Novaky
Czech Gas Transit System
Uzhgorod
Vojany
Bratislava
Leninvaros
Gyor
Szony
Budapest
Debrecen
Szombathely
Szazhalombatta
Szolnok
Lake Balaton
ROMANIA
HUNGARY
Paks
City
Major Refinery
Oil Field
Gas Field
Szeged
Pecs
Danube
Osijek
Vukovar
Gas Pipeline
0 25 50 Km
0 25 Miles
Novi Sad
YUGOSLAVIA
Slavonski

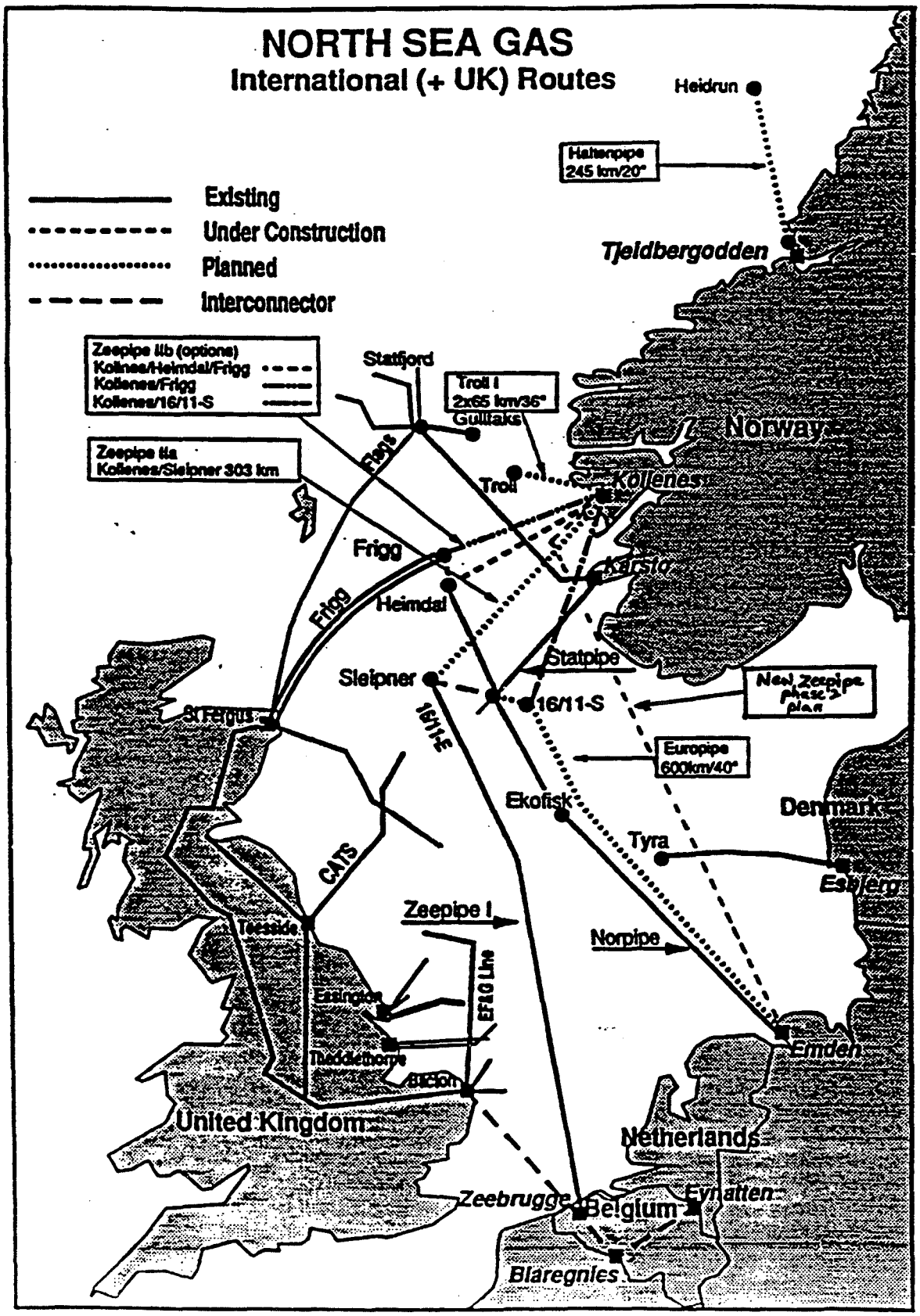
Existing and planned Norwegian gas pipeline network

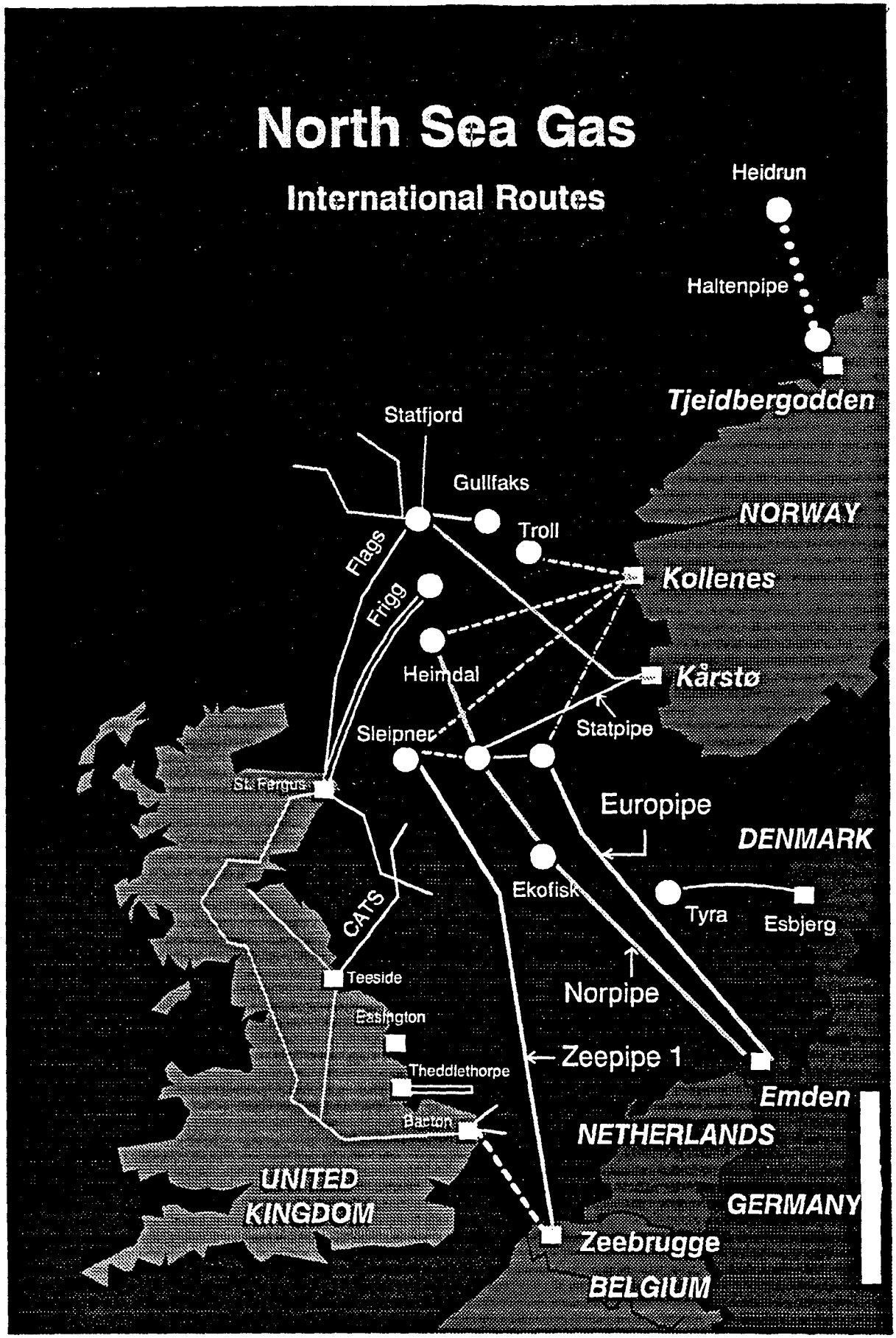
Gas pipelines	Start-up date	Initial capacity (10^9 m³/year)	Length (km)	Diameter (inches)	Fields/ Border station	Receiving countries
EXISTING						
Norpipe	Sept. 1977	19	443	36	Ekofisk/Emden	Germany - Belgium-France - Netherlands
Statpipe	May 1986		882	28, 30, 36	Statfjord-Gullfaks/Emden	Germany - Belgium-France - Netherlands
Frigg	August 1978	12	350	32	Frigg/St Fergus	United Kingdom
PLANNED						
Zeepipe (Phase 1 & 2)	October 1993	12	1150	40	Troll-Sleipner/ Zeebrugge	Belgium - France-Spain
Europipe	1995	12	630	40	Emden	Germany - Austria Netherlands
Norwegian network capacity		55				

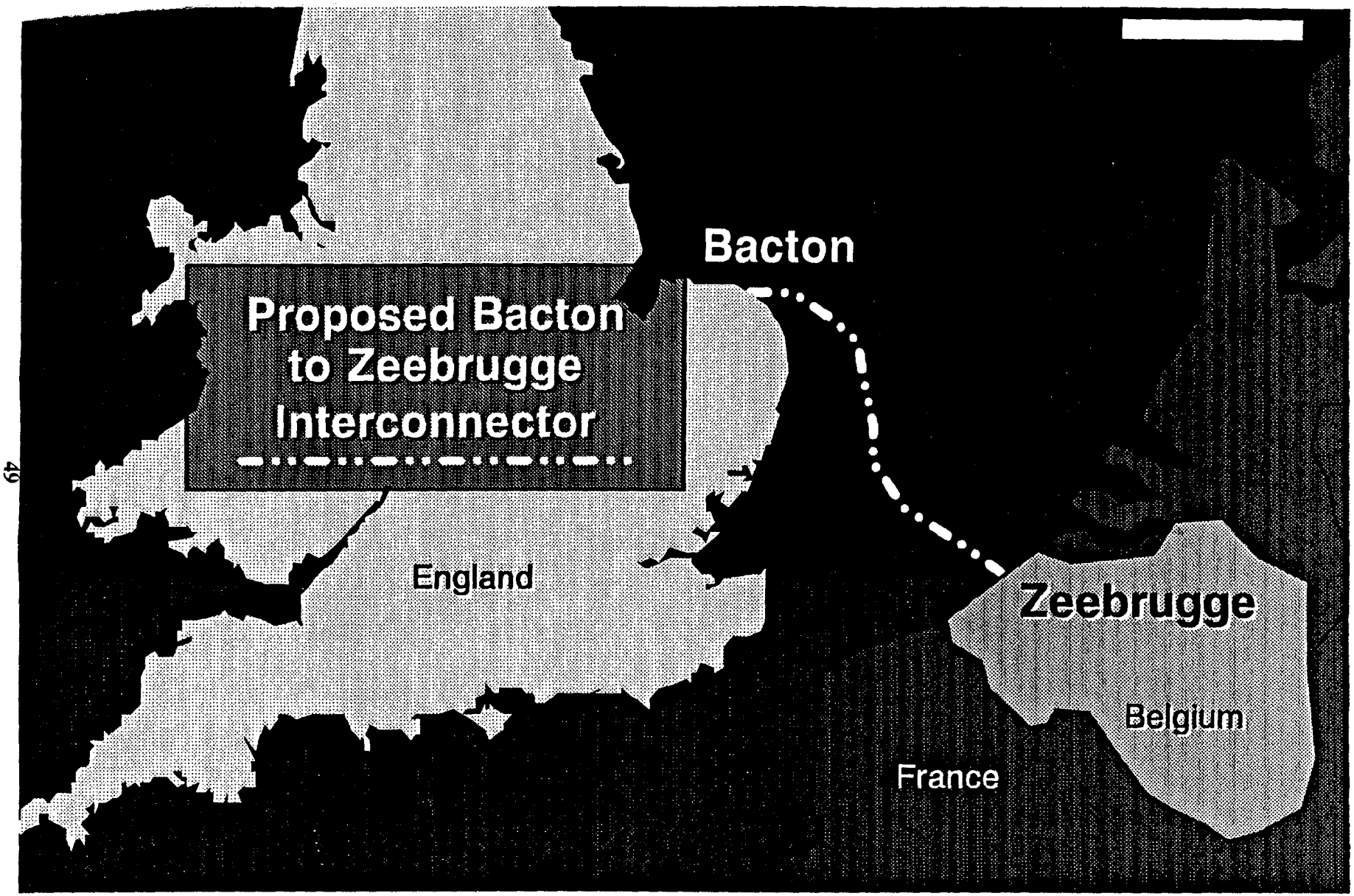


NORWAY'S OFFSHORE GAS GRID


Norway's North Sea options
Statfjord
Gullfaks
Troll
NORWAY
Kollenes
Heimdal
Kårstø
Sleipner
Europipe
Ekofisk
DENMARK
Zeepipe
Norpipe
Emden
UNITED KINGDOM
NETHERLANDS
GERMANY
Zeebrugge
Calais


NORTH SEA GAS
International (+ UK) Routes
Existing
Under Construction
Planned
Interconnector
Heidrun
Haltenpipe
245 km/20"
Tjeldbergodden
Zeepipe IIb (option)
Kollnes/Heimdal/Frigg
Kollnes/Frigg
Kollnes/16/11-S
Statfjord
Troll I
2x65 km/36"
Gullfaks
Norway
Zeepipe IIa
Kollnes/Sleipner 303 km
Rørs
Troll
Kollnes
Frigg
Karsto
Frigg
Heimdal
Statpipe
Sleipner
16/11-S
St Fergus
16/11-E
Europipe
600km/40"
Ekofisk
Denmark
Tyra
CATS
Esbjerg
Zeepipe I
Teesside
Norpipe
Easington
EF10 Line
Theddlethorpe
Emden
Barton
United Kingdom
Netherlands
Zeebrugge
Belgium
Eynatten
Blaregnies


North Sea Gas
International Routes
Heidrun
Haltenpipe
Tjeidbergodden
Statfjord
Gullfaks
Troll
NORWAY
Flags
Frigg
Kollenes
Heimdal
Kårstø
Statpipe
Sleipner
St. Fergus
Europipe
DENMARK
Ekofisk
Tyra
Esbjerg
CATS
Teeside
Norpipe
Easington
Zeepipe 1
Theddlethorpe
Emden
Bacton
NETHERLANDS
UNITED KINGDOM
GERMANY
Zeebrugge
BELGIUM


Bacton
Proposed Bacton
to Zeebrugge
Interconnector
England
Zeebrugge
Belgium
France


NATURAL GAS IN EASTERN EUROPE
Baltic Sea
Rostock
Gdansk
Elblag
Minsk
Olsztyn
Szczecin
Northern Lights Pipeline
City
Gas Field
Gas Pipeline
0 100 200 Km
0 100 Miles
ERMANY
Pila
Torun
Plock
POLAND
Warsaw
Leuna
Pulawy
Lublin
Wroclaw
Kielce
Tarnobrzeg
USSR
Kiev
Prague
Katowice
CZECHOSLOVAKIA
Bratsvo Pipeline
L'vov
Nowy Sacz
Czech Transit System
Soyuz Pipeline
Linz
Mukachevo
Vienna
Bratislava
Gyor
AUSTRIA
Debrecen
Baia Mare
Iasi
Szombathely
Budapest
Szazhalombatta
ROMANIA
HUNGARY
Cluj-Napoca
Gheorghe Gheorghiu-Dej
Jesenice
Pecs
Nova Gorica
Timisoara
Hunedoara
Brasov
Galati
Zagreb
Sisek
Vukovar
Sibiu
Bosanski Brod
Novi Sad
Pancevo
Belgrade
Bucharest
Craiova
Sarajevo
Nis
Pleven
Varna
YUGOSLAVIA
Adriatic Sea
Stara Zagora
Black Sea
Sofia
Dimitrovgrad
ALY
BULGARIA
TURKEY
Tirana
ALBANIA
GREECE
Aegean Sea
Ionian Sea

EAST EUROPEAN DIRECTORY

Country/Organization/Contact	Type	Address	Telephone	Telex
ALBANIA				
Albanian Chamber of Commerce Liqor Dhamao, Chairman	Government	Tirana	...	...
Minergoimpex	Import/export of oil	Marsel Kashen No. 86 Tirana	...	...
Ministry of Foreign Trade Aleksandra Collaku, Director	Government	Tirana	...	...
Ministry of Natural Resources and Energy Mr. Bejo Sejdini, Director, Oil and Gas	Government — handles offshore exploration	Tirana	22148 Fax: 34031 or 34077	2238
BULGARIA				
Comgeo — Committee of Geology & Mineral Resources	Oil and gas exploration and production	22 G. Dimitrov Blvd. Sofia 1000	(359) 283-2767	...
Energoimpex	Import/export of energy	Blvd. Ernest Thelmann 17a PO Box 80 Sofia 1000	(359) 518-867	22669
Energy Association	Government office for energy	Priaditza St. 8 1000 Sofia	(359) 861-91	22707
Neftochim Combinat	Refinery and petrochemical plant	8104 Burgas 454-98	(359)	83506
CZECHOSLOVAKIA				
Czechoslovak Academy of Sciences Institute of Information	Government	Pod Vodarenskou 182 08 Prague 8	(42-2) 815-2277	...
Federal Ministry Of Economy Director For Oil & Gas	Government	Vinohradska 8 Prague 2	(42-2) 260-442	...
CZECH REPUBLIC				
Chemapol	Oil importer	Kodanska 46 10010 Prague 10	(42-2) 736-840	122021
Chemopetrol	Refineries at Litvinov and Kralupy	Tropska ul. 13a 18000 Prague 8	(42-2) 847-241	122273
Czech Gas Enterprise Miroslav Grec, Director	Natural gas distribution	Revolucaf 2 11151 Prague 1	(42-2) 235-6878 Fax: (42-2) 235-6759	122780
Fuel Research Institute Jaroslav Myslivecek, Director	Research center	Bechovice 25097 Prague	(42-2) 741-240	...
Ministry of Economic Policy & Development Gas & Energy Dept.	Czech. Republic Government	Vrsovicka 65 Prague 10	(42-2) 712-1111 Fax: (42-2) 236-0697	...

Country/Organization/Contact	Type	Address	Telephone	Telex
	SLOVAK REPUBLIC			
Ministry of Economy Energy Dept.	Slovak Government	Bratislava	...	...
Ministry of Industry	Slovak Government	Stromova 1 83336 Bratislava	(47-2) 37-26-3	092543
Oil & Gas Research Institute Dr. Jaroslav Janku, Director	Research center	Mlyaske Nivy 46 2505 Bratislava	(42-7) 653-66	...
Slovak Gas Industry Ladislav Cervenak, Director	National gas distribution	Mlynske Nivy 44A 82511 Bratislava	(42-7) 643-51 Fax: (42-7) 67530	092299
Slovnaft Odborovy Podnik	Refining and petrochemical plant	Vlicie Hrdlo 82412 Bratislava	(42-7) 243400	93285 or 92243
	HUNGARY			
Danube Refinery (DKV)	Refining	Dunai Koolajipari Vallalat PO Box 1 2443 Szazhalombatta	(36-1) 162-0673	225435
Mineralimpex Jozsef Tothe, Director	Foreign trade in oil	Nepkoztarsasag PO Box 130 1389 Budapest	(36-1) 1316-720 or 1116-470 Fax (36-1) 153 17 79	224651
		Or		
		Benczier Utja 13 1068 Budapest	(36-1) 118-8233 Fax (36-1) 142-3584	226570
Ministry of Industry & Energy	Government	Martirok utja 85 Budapest 2	(36-1) 1565-566	...
OKGT Dr. Jozsef Subai, Commissioner	State oil and gas company	Schonherz Zoltan u. 18 H-1502 Budapest, pf. 22.	(36-1) 1664-000 or 1669-022 or 1 853-944 or 1868-55 Fax (36-1) 1868-281 or 1850-109	224762
	POLAND			
Ciech-Petrolimpex	Oil trade	Ulica Jasna 1000013 00950 Warsaw	(48-22) 267-201 or 260-364	814227 814961
CPN	Fuels distribution	Ulica Mysia 2 00950 Warsaw	...	...
Ministry of Finance	Government	W. Sweitokrzyska 12 00916 Warsaw	(48-22) 694-5974	
Ministry of Industry Energy & Fuel Management Dept. Dr. Kazimirz Adamczyk, Director	Government	Wspolna 4 00926 Warsaw	(48-22) 280-801	814267
MZRIP — Mazowieckie Zakladyh Rafineryjne I Petrochemiczne	Refinery and petrochemical plant	Ulica Chemikow 7 09403 Plock	(48-2) 863-53282	83341

Country/Organization/Contact	Type	Address	Telephone	Telex
POLAND (continued)				
Petrobaltic	Offshore exploration	Ulica Chmielna 81-82 Gdansk	...	81171
Polish Oil & Gas Co. Mieczyslaw Kaczmarczyk, General Manager Dr. Piotr Karnkowski, Chief Geologist	Exploration, production, and gas distribution	Ul Krucza 36 00921 Warsaw	(48-22) 280-241 or 281-642 Fax (48-22) 290 856	813466
World Bank	Representative office	Intraco I Building 17th Floor Warsaw	(48-22) 635-553	...
ROMANIA				
Geomin	Exploration	Calea Victoriei 220, Bucharest	(40) 592-930	11242
Ministry of Mines Petroleum & Geology Marin Stafanache, Minister	Government	Str. Mendeleov 36 Bucharest	(40) 597-045	11263 MIME R
Ministry of Refining & Petrochemical Industries Dr. Valentin Ionita, Director	Government	202a, Spiaul Independentei 70039 Bucharest	(40) 815-395	11171
Petrolexportimport	Petroleum trade	Maghery Blvd. 1-3 70161 Bucharest	(40) 131-249	11519
Romanian Development Agency Mr. Negritoiv	Government	Blvd. Magheru 7 Bucharest	(40) 156-686	11027
Rompetrol Mr. Calinescu, General Manager	State oil company	109 Calea Victoriei Bucharest	(40) 595405	10155
YUGOSLAVIA				
Federal Comm. For Energy & Industry	Federal government	Omladinskih Brigada 1 Belgrade	(38-11) 602-366	11448 YU SIV
BOSNIA-HERCEGOVINA				
Energoinvest Sarajevo Rio Rafinerija Nafte	Refining plant	Ulica Marsala Tita 184 74450 Bosanski Brod.	(38-74) 861-022	44584
CROATIA				
Enconet International	Consultants	Unska 3 41000 Zagreb	(38-41) 629-987 Fax: (38-41)629-880	...
INA-Naftaplin Josip Kriz, Director	Exploration and production	Subiceva 29 41000 Zagreb	(38-41)	21430
INA — Industrija Nafte	Oil and gas production	Ulica Proleterskih Brigada 78 41000 Zagreb	(38-41) 516-411/66	21223
INA-Oki	Petrochemicals	Zitnjak bb PO Box 402 41000 Zagreb	(38-41) 213-001 or 214-090	21430
INA-Rafinerija Nafte	Refinery	B. Kidrica bb 44000 Sisak	(38-44) 322-43	23615

Country/Organization/Contact	Type	Address	Telephone	Telex
INA-Rafinerija Zagreb	Lubricants	Radnicka Cesta 175 PO Box 270 41000 Zagreb	(38-41) 213-666	21777
	MONTENEGRO			
Yugopetrol Danilo Grba, Managing Director	Oil distribution	85330 Kotor Montenegro	(38-82) 142-10	...
	SERBIA			
Jugopetrol	Trade of petroleum products	Masarikova 5 20 Belgrade	(38-11) 688-673	12311
Naftagas	Production, refining and marketing	Sutjeska Br. 1 21000 Novi Sad	(38-11) 615-144	14196
Naftagas Geophysical Institute Petar Vojnovic, Director of Geophysics	Exploration	Karadordeva 48 11000 Belgrade	(38-11) 626-168	...
Plinarin	Gas production and distribution	Paje Marjanovica 8 26000 Pancevo	(38-13) 31-82	...

Background

The market potential of the former Soviet Union (and central and eastern Europe) is enormous. The social, political and economic conditions in much of the area are still unclear and fraught with tensions. It is often hard to understand fully what is happening now and what it may lead to but the region still attracts a lot of interest from business as well as global policy makers. Some commentators estimate that around £200 million a year is being invested to develop new oil and gas projects in the FSU countries although generally, rewards do not yet justify the level of investment required. Apart from financial and other help, western Europe and the rest of the world's markets are encouraged to welcome eastern European products as part of the drive to rebuild that part of the world and to create a competitive environment which will underpin the route to real democracy. The thinking of the European Union in setting up the Energy Charter could be one way to assist the development of energy imports from the FSU, as long as it continues to be based on the principles of market economy with a legislative framework limited to setting up precise guidelines for investment protection and trade.

The results of the December 1993 elections for the new Russian parliament could significantly slow down the process of foreign investment involvement in the Russian oil and gas industries. But nevertheless, if that slowdown takes place, in two to three years Russia might well be expected again to open its energy economy to foreign investment when the external financing priority would be project financing.

An interesting commercial development concerns Gazprom, the world's biggest gas company, which produces ten times the entire North Sea output each year, has 35% of world gas reserves and about 130,000 miles of pipelines. Although it sells 3.6 tcf of gas per annum to Europe 80% of its production is sold internally. Kleinwort Benson are currently advising on its intention to sell 9% of its shares to global investors. The company has joint ventures with Western gas companies such as Australia's BHP Petroleum and Germany's Wintershall.

Russia

(1) **Upgrade of existing pipeline system.** The European Bank for Reconstruction and Development is to manage an $8.6 million, 12 to 18 month modernisation evaluation of the 83,800 mile Russian gas pipeline system. Goals are a list of priority projects and prefeasibility studies. Funding for the evaluations is said to be coming from the UK, Canada, France, the Netherlands, Norway, and the U.S. Hope is for promoting political stability in Russia, work for national companies, and enhanced European supply security.

It had earlier been reported that no less than 50,000 miles of Russian gas lines had been earmarked for repair or complete reconstruction. But lack of funds means the programme has already fallen far behind schedule. Of 9,200 miles scheduled for repair or reconstruction over the 1991-95 period, only around 2,500-3,000 miles will be dealt with, leaving an even more crowded schedule for the following three rehabilitation periods.

Already, 1996-2000 is lined up to handle 11,000 miles with a further 15,000 miles earmarked for attention during 2000-2005. Biggest slice of all comes in 2005-2010, when no less than 16,000 miles are scheduled for attention. On top of that, 2,817 distribution stations need urgent attention. And 67 of the nation's 226 compressor stations need work ranging from rehabilitation to complete rebuilding.

In this latter regard it is reported that companies from Britain, Germany, Italy and the USA have tendered for re-equipment of compressor stations serving Russia's 84,000 miles of gas trunkline with new generation technology.

This would enable each compressor station, at about 60 mile intervals, to save 400-575 mcf/year of gas for each pumping unit, increase throughput and boost reliability.

If the overall rehabilitation plan is not carried through the likelihood exists of the system losing capacity equal to 860 bcf/year. That could seriously affect exports to Europe and is one reason for Russia's call for technical and financial help from its biggest export customer areas. If, however, the plan does go through, gas losses in transmission could be cut by 50%, while upgrading of compression could cut the total number of stations by 43 and installed capacity by 1,000 MW. Of the 67 stations in line for upgrading, 15 need complete replacement, nine need compressor rehabilitation, while the remaining 43 require new compressors totalling 4,200 MW installed capacity.

The first five-year tranche of the massive workload has been assisted by the extending of a $1.6 billion loan to Russia underpinned in large measure of two Italian bankers, Mediocredito Centrale SpA and recently privatised Banca Commerciale SpA. According to Mediocredito Centrale SpA, a medium term credit group, the loan will help finance a $1.9 billion contract with Russia's Gazprom for the Tragaz consortium of ENI group companies, Nuovo Pignone and Snamprogetti. Work will include recovering extra gas leading to increased deliveries to Italy's Snam of 200 bcf/year over a 20 year period starting in 1995.

According to Mediocredito, the loan, which will allow Russian gas utility Gazprom to pay for the services, was the largest to date in support of Italian exports. Over 40 banks from Italy, seven other European countries, the United States and Japan are also taking part.

The loan will pay a fixed interest rate of 5.71 per cent. The operation is 95 per cent covered by Italian export credit guarantee department SACE, with the remainder guaranteed by the exporters. Under the agreement, state gas transport group SNAM SpA will pay the money for gas it imports from Russia into a special "escrow account" which will provide a source for the repayment.

As part of the upgrading program the state organisation in Russia, Gazprom, has placed a contract, worth $125 million, with AEG to automate the northern section of its national gas pipeline network. The northern section comprises four pipelines, each 750 miles long, which carry gas from North Tjumen to the industrial centres around Moscow and St. Petersburg. In order to continue to satisfy the growing demand for energy, two additional pipelines are to be laid and automated by AEG. By the end of

1995, six pipelines are planned to raise the present transport capacity of 3.2 tcf natural gas to 4.0 tcf per annum.

The AEG control system is based on three hierarchy levels. The first level includes a total of 66 control systems for compressor plants, with 132 redundant Modicon A500 programmable logic controllers and 13 compressor station control systems - with 34 redundant PCs. Visualisation is provided by Viewstar control and monitoring stations, part of AEG's Geamatics automation system. They provide dispatchers with an overview of the total supply network. Operation at this upper level is divided into a SCADA system and leakage detection.

(2) **Yamal Peninsula Development.** Construction of the first part of the 3,000 mile gas line system due to connect the remote Yamal Peninsula to Western Europe has started with the laying in summer 1994 of a 125 mile section across Belarus and a 60 mile section across Poland.

The giant Kharasveyskiy and Bovanenkovskiy gas fields are to be developed with gas exported via a six gasline system to central Russian regions, other former Soviet states and other countries. Pipeline capacity is over 6 tcf a year, estimated cost is $10 billion and completion target year is 2010.

The most complex section for builders is located at the start of the pipeline, the Baidaratskaya Bay on the west coast of the Kara Sea. Pitergas, formed by Gazprom and Khirema of Holland, has prepared a plan for the subsea laying of the pipeline. Two pipelines of the network (50 miles 48 in.) are scheduled - optimistically - for completion by end 1996.

At the demand end of the system, Ruhrgaz and Gazprom are considering co-operation, with Gazprom's sole German partners in the project being Wintershall and two Gazprom/Wintershall joint ventures, WIEH and Wingas. Wingas will build two pipelines through Germany to connect western European lines with the Yamal pipes at Frankfurt/Oder, at the German-Polish border. One line will continue through Germany toward the Dutch/German border. The other will travel through eastern Germany to Bavaria, and continue to Basle where it will link with French and Swiss networks.

(3) Gazprom intends to expand its southern pipeline route for gas exports to western Europe which passes through Ukraine, despite the problems that have arisen between Moscow and Kiev over the line and the determination to build a new line to feed western Europe via Belarus and Poland.

(4) The oblast administration of the eastern Russian Kamchatka peninsula is to finance construction of a gas pipeline to boost local energy sources instead of high-cost imports. The first 87 mile section of the line will run from a gas deposit to Soboleve, nearest district centre in the southern part of the peninsula.

(5) Construction of a gasline to Salekhard, capital of Yamal-Nenets autonomous okrug, started in the first half of 1994.

It will run from a compressor station on a trunkline carrying northern gas to central Russia.

(6) The recently formed joint venture of Finnish Neste and Russian Gazprom - Gasum - is considering building a new Russian gas pipeline via Finland to markets in continental Europe primarily to provide a safe route. Gazprom has been seeking to diversify export routes but how a Finnish route would fit with other plans, for instance, the Statoil-Neste proposal described elsewhere remains to be seen. As well as the major Yamal line proposed via Belarus and Poland, expansion of deliveries via Ukraine appears on the cards, despite past Russo-Ukraine disputes over the route which currently ships about 90% of Russian exports.

Meanwhile, Gasum is also conducting feasibility and political risk studies on exporting Russian gas to Sweden after 2000 if Swedish nuclear power is wound down, about which a political battle is being fought. The gas supply plan has been around since the early 1980s when originated by Neste.

(7) Enron Corp., Houston, and Gazprom, Russia's major natural gas company, has announced a framework agreement for development of new markets for Russian gas in the European power sector.

Enron will contribute its experience and expertise in identifying, evaluating, developing, contracting, financing and negotiating gas sales and power purchase contracts for independent power projects. Once development of a project begins, it is expected that Enron will take the lead in raising project finance.

Gazprom will contribute its expertise in negotiating gas contracts in Europe and will be responsible for delivering the gas. It is expected that in all projects undertaken, Gazprom will participate as a direct equity investor.

(8) Scientists have designed an aircraft engine that can switch from aviation fuel to natural gas. Plane maker Tupolev is reported to be working on further designs with Airbus industries.

(9) Other planned lines include:

- 2,814 miles 56 in. gas transmission line from Yamburg to Zakavkazye to Gorky
- 1,906 miles 56 in. gas transmission line from Gorky to Talla to Kiev
- 1,713 miles 56 in. gas transmission line from Kiev to Novelzhr
- 4,944 miles of gas transmission line of various sizes.

(10) **The Shtockmanovskoye gas-condensate field,** discovered in 1988 in the Central Barents Sea, is (another) candidate for serving the European market. This field, whose reserves are estimated at well over 100 tcf, is located in the Arctic Circle 350 miles off

the Soviet coast. The sea depth in the area is 750-1000 feet. Gas is methane with no sulfur.

In 1991, the first phase of feasibility studies conducted by the Conoco-led western consortium including Norsk Hydro, Neste Oy, Imatran Voima and Metra was completed. This looked at several options for transportion of gas from the field to Scandinavia, East and West European markets (Poland, Germany, Italy) and markets within the former Soviet Union. The Shtockmanovskoye Field might be expected to produce a plateau level of 890 billion a ft/year towards 2010. Two strings of gas pipelines of about 48 in. diameter would link the platform to a gas terminal at Murmansk. The cost of the Shtockman project has been put by the foreign consortium at some $8-10m billion over a 15 year period (including an export pipeline from Murmansk to the German Border).

Azerbaijan

(1) Gaz de France unit Sofregaz has completed consultations with state oil company Azerigaz on reconstruction of Azerbaijan's gas pipeline system. Sofregaz won a World Bank tender for the project. Reconstruction would be put into effect with this World Bank assistance and the Japanese government would provide $775,000 for technical preparation of a draft scheme.

(2) The partners in a BP led consortium of Western oil companies are involved in a new $4.5 billion extraction deal with the former Soviet Republic. A consortium of three British companies, British Gas, National Power and Power-Gen may build a gas-fired station there. However doubts about the contract have been expressed by the Russian Foreign Minister.

Caspian Sea

There is considerable attention being devoted to the issue of pipeline transportation options for Azeri and Kazakh oil from the Caspian Sea region and to Turkmen and Kazakh natural gas transportation.

The Turks are pressing the merits of routes through their territory, one of which would cross Georgian and Iranian territory (somewhat politically inhospitable). Other routes under study involve passage through Russia and Ukraine; a route to the Gulf traversing either Afghanistan, Iran or Pakistan; and, even a route along the old Chinese "silk route" to the potentially rich markets of East Asia. With so much at stake and the size of the benefits to be derived, the issue is creating interest in governmental and corporate circles. The strategic importance of pipeline routes for this abundantly located resource is clear.

In a separate move, Russia has demanded the right to veto any Caspian oil deals between its former Soviet neighbours and the West.

Kazakstan

There are rumours that British Gas is losing patience at the slow pace of talks. Following two years of planning for the $6 billion exploitation of the Karachaganak oil field it is understood that British Gas and its joint venture partner Agip have still not reached an export agreement t for the field. It is also reported that Gazprom the giant Russian gas company will be joining the consortium.

Georgia

New imports of Russian gas will not flow through the existing pipeline from the west. Instead, they will enter eastern Turkey via a new 260 mile line able to handle 86 bcf/year.

The Turkish government has signed an agreement with Georgia to look into the planned line, which would start at Mamrelli, south of Tbilisi and run to Erzurum.

From the latter a 550 mile extension would later take the new supply through to Ankara.

Hope is that the new route will do away with recent winter supply problems, when there was disruption on the sole import line.

Turkmenistan

Turkmenistan at present exports gas to other former Soviet republics via the Russian pipeline network, but (like Russia) would dearly like to break away from its dependence on those markets. Turkmenistan makes little secret of its wish to get into new markets: according to one estimate, the country produced 2.88 tcf in 1993 and plans to increase this to 7.2 tcf/year by 2004. Its proven reserves put at 88.1 tcf while potential reserves are estimated to be 364 tcf.

Turkmen ambitions centre on a grand energy strategy comprised of three large pipelines optimistically in place by the year 2000. These are:

- Europe via Iran and Turkey (capacity 988 bcf a year) See below
- Arabian Sea via Afghanistan and Pakistan (capacity 706 bcf a year) See Indian subcontinent section
- Japan via China (capacity 988 bcf a year). See Far East section.

During 1994, discussions and negotiations made headway regarding the possibility of building a pipeline through Iran to move gas to Europe via Turkey. An important development was the backing given by Russia to the plan in the early part of the year.

In a much more important development, energy ministers from all four countries of Turkmenistan, Iran, Russia and Turkey signed a memorandum setting up a joint committee called the "interstate council" which is to co-ordinate gas (and oil) exports from Turkmenistan to a range of markets in the former USSR and Europe.

It is reported that the four countries have approved the proposed route for the pipeline, which would first run westwards to Teheran before turning north to Tabriz and into Turkey, (and, thence, to the Bulgarian border), although this is not the only Turkish idea under consideration. The Turks have advanced three alternative routes from Turkmenistan.

Two of these routes cross the Caspian Sea to Baku in Azerbaijan and run via other hostile neighbours such as Georgia and Armenia. The third goes via Iran. Naturally, the first two require political as well as economic developments first.

The Turkmenistan-Iran-Turkey-Europe pipeline plan still faces huge hurdles: the project will be very long, very big and very expensive. Turkish sources have said the transmission system would be about 3,300 miles long and would require two parallel 56 inch pipelines and 14 compressor stations. Capacity had been planned at up to 1.44 tcf/year and the cost was estimated at around $10 billion. (Although in August 1994 it was reported that Iran and Turkmenistan had agreed to build a $7 billion line linking the Caspian Sea with the Black Sea, via Turkey). It is understood that Zangas/Pensren are developing engineering and economic specifications.

A natural gas sales agreement signed last year by Turkish State gas company, Botas and Turkmengaz set out the volumes of gas which Turkey would import from Turkmenistan once the project was realised. The volumes specified would rise steadily from 72 bcf in 1995 to 360 bcf in 2000, 540 bcf in 2005 and 720 bcf in 2010. However, this accounts for only half of the envisaged total capacity of 1.44 tcf and thus the remainder must be destined for further markets yet to be involved. The sales agreement was made under the auspices of a protocol signed by the governments of Turkey and Tukmenistan in 1992 which stated that Turkey would transmit gas from Turkmenistan to third countries over a 30 year period.

The Turkish pipeline "project" is a very far off prospect. It will be subject to very strong competition, not least of all from Russia, whose agreement with Turkmenistan may well have been signed but it is likely that their ultimate aims oppose rather than complement each other. Key details such as financing for the project have yet to be negotiated, much less settled upon - and it appears Turkmenistan will look to potential customers in western Europe for project backing. It is hard to believe that they will be interested in such an idea - although mid 1994 reports indicated that French companies are to help with the project.

Turkmen authorities have said that other parties would be invited on to the "interstate council" if they wanted to support the project. While this appears to be an offer to potential European customers to take a role in the project, it could also be seen as an opening for Uzbekhistan to join in the plan as a supplier to European markets in partnership with Turkmenistan.

Specific details and other information emerging during 1994 on the transfer of Turkmen gas to Europe via Iranian territory confirm the decision that the pipeline should pass through Iranian territory to be definite. On the basis of preliminary estimates, about $2.7 billion would be used for the construction of the 800 mile route inside Iranian territory.

The route of the line inside Iranian territory would be from eastern Mazandaran to Shahrud, Semnan, south Tehran and Tabriz. This route would then continue through Turkey to Europe. Once the project was financed it is expected that implementation would be assigned to Iranian contractors.

However, it can be argued that central Asian countries will, in time, realise that their only realistic prospect of supplying gas to Europe is through Russia. If they do not find this option acceptable they can always look southwards towards Pakistan. Turkmen officials meanwhile are reported still to be interested in plans to export pipeline gas eastwards to China as evidenced by conclusion of a draft agreement between Turkmenistan, China and Japan to export Turkmengas to the Far East with China building the necessary pipeline under a bilateral protocol of intent.

Ukraine

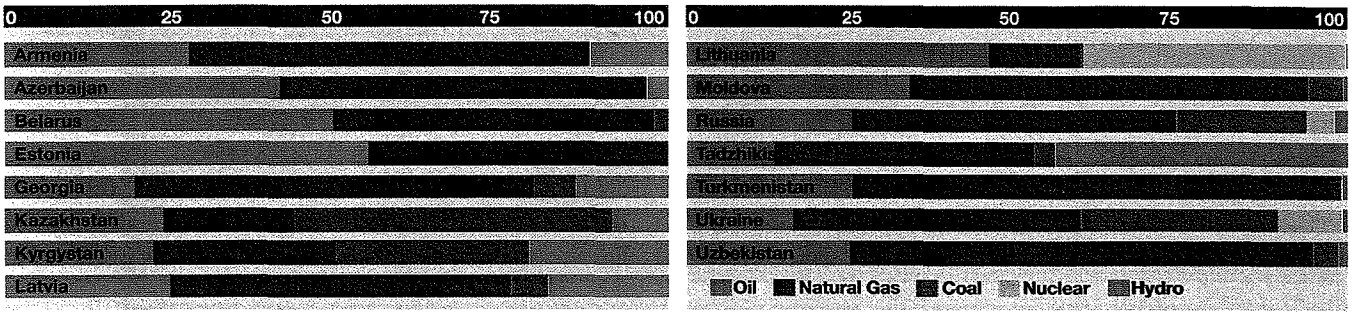
Russia and Ukraine have signed a deal to create a joint stock company for development of transit pipelines carrying Russian natural gas across Ukraine to Europe. At the same time Russian Gazprom and Ukraine's Ukrhazprom fixed a payments schedule for the debt of over $800 million Ukraine still owes Russia for gas. A further agreement will also provide for Ukrainian companies to make direct gas supply deals with Gazprom. Ukraine is due to meet some of its debt via provision of manufactured goods and housing for workers in the Russian gas industry. As a separate issue, the Ukranian parliament has demonstrated its opinion that privatising the country's gas pipelines would weaken the Ukranian state.

Uzbekistan

Planning proceeds for the 56 mile gas pipeline from the Gazli deposit near Bukhara to Khorezm and Karakalpakistan in the northern region.

Primary energy fuel shares 1993

% by fuel

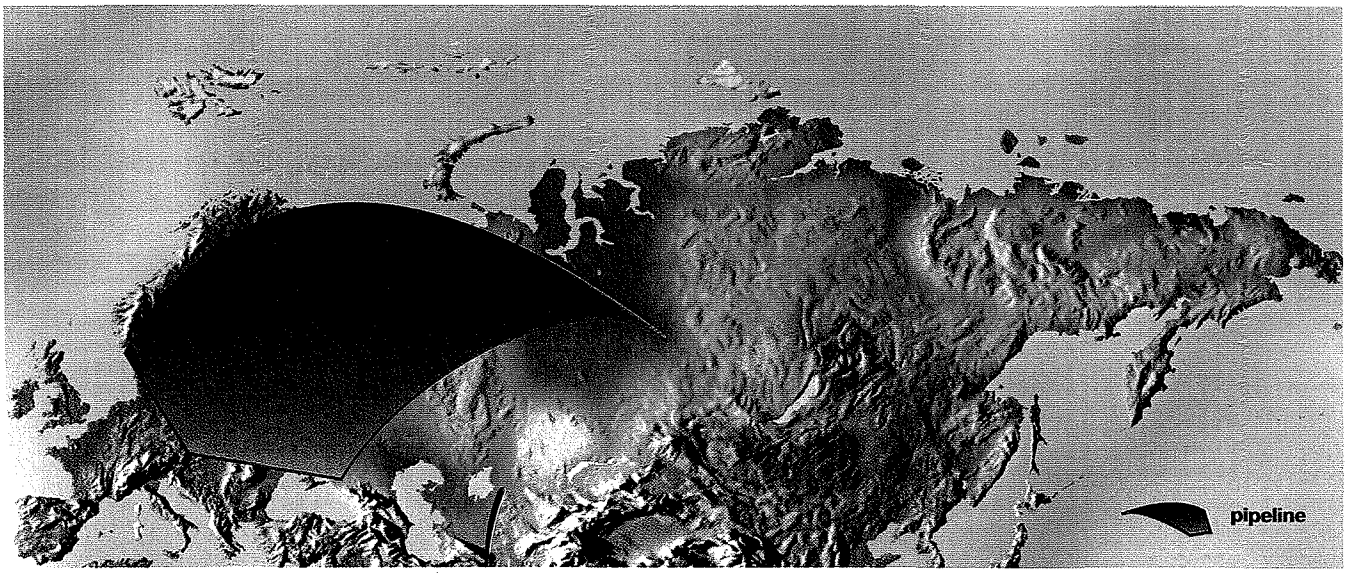


Imports by pipeline 1993

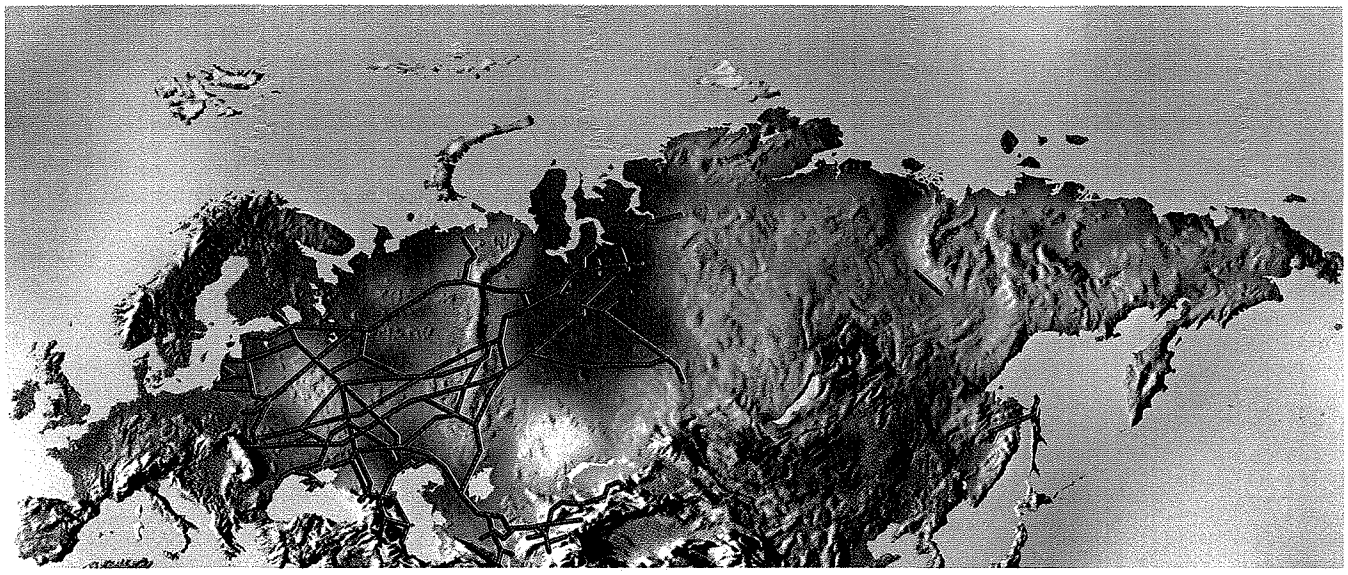
(bcm)

EXPORTER													IMPORTER
USA	Canada	Bolivia	Mexico	Denmark	Germany	N'lands	Norway	UK	FSU	Iran	Algeria	Malaysia	Total Imports
										0.50			FSU 0.50
										0.50			

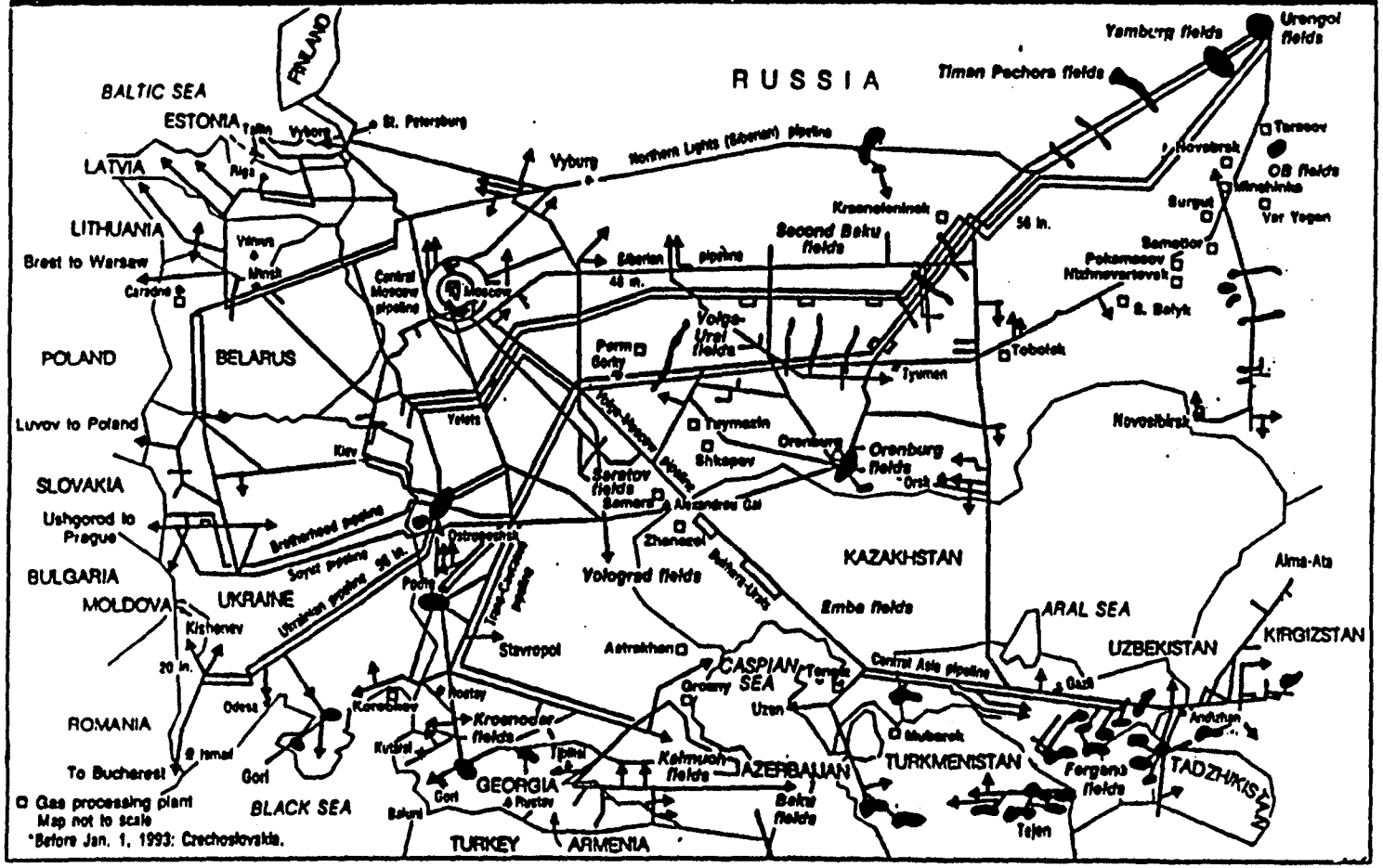
Inter country/regional trade flows

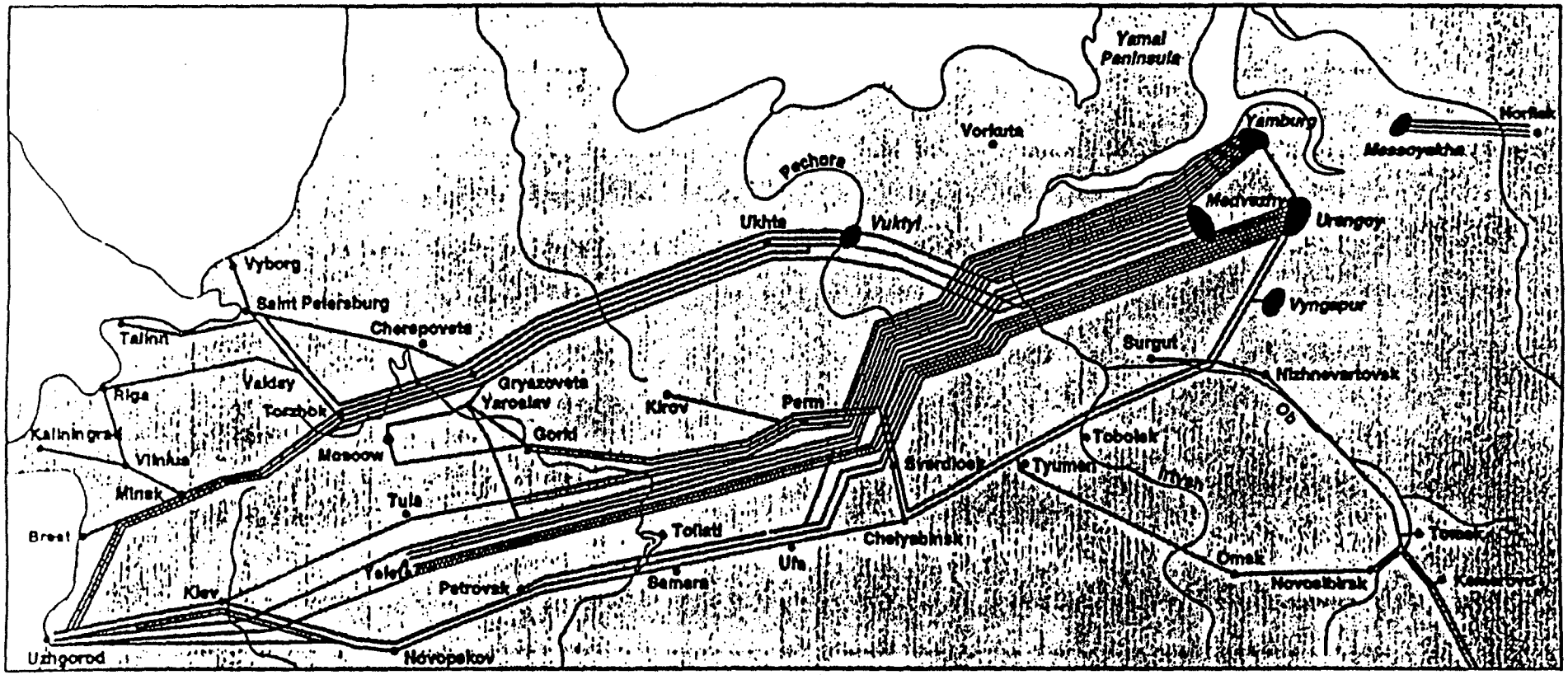


Major pipelines

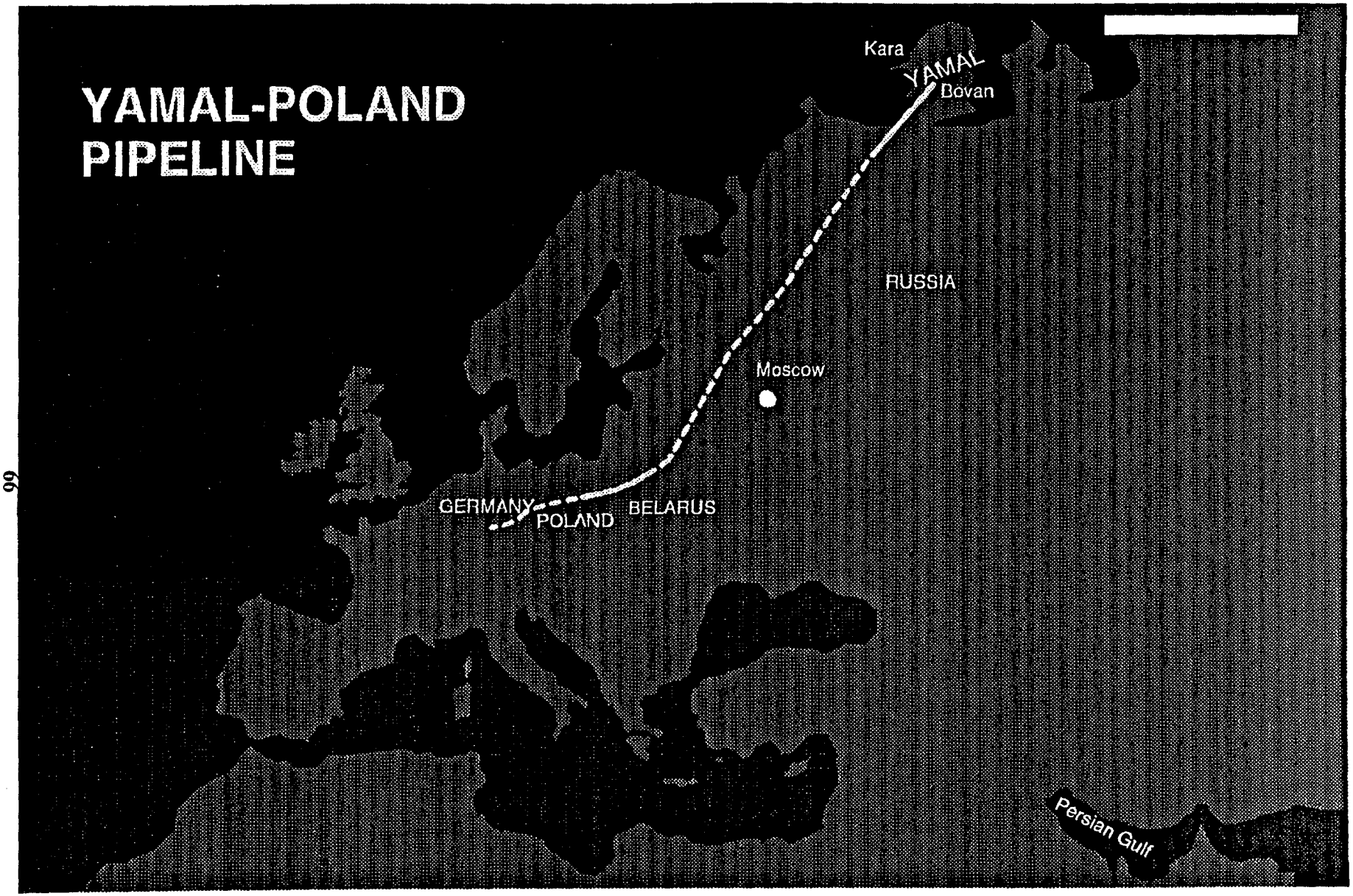


C.I.S.-AREA NATURAL GAS PIPELINES

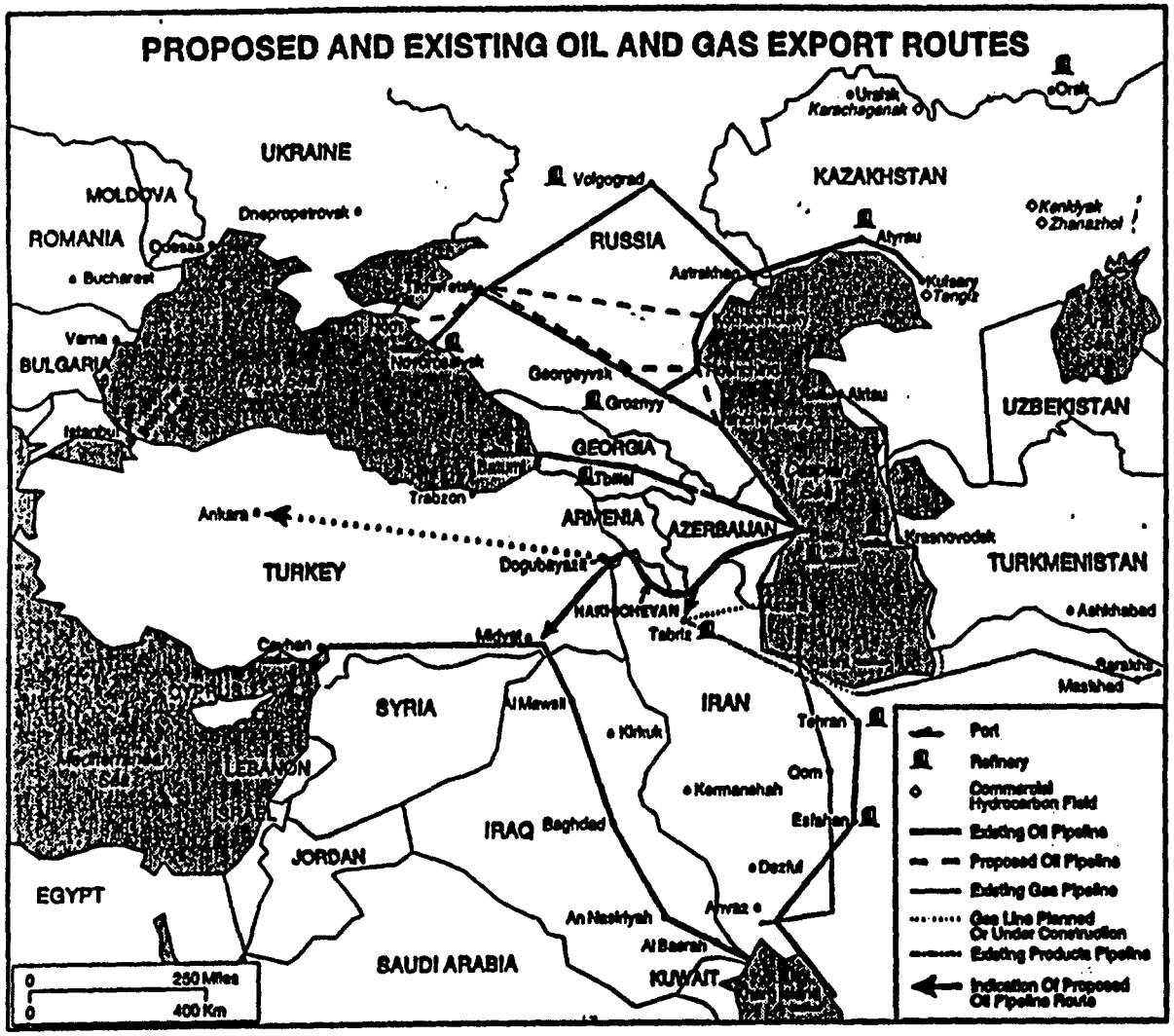




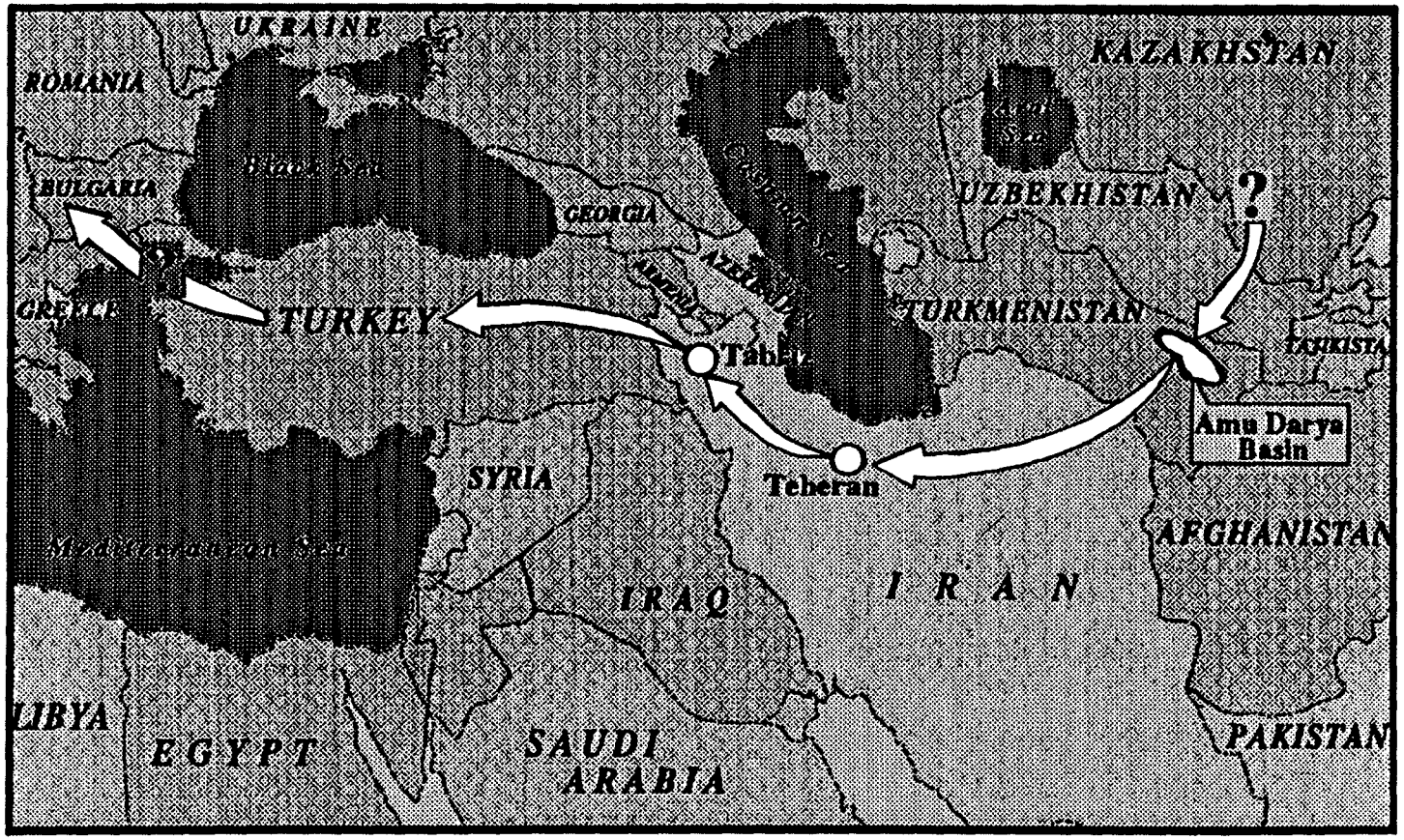
MAIN OPERATING GAS PIPELINES IN WESTERN SIBERIA


YAMAL-POLAND
PIPELINE
Kara
YAMAL
Bovan
RUSSIA
Moscow
GERMANY
POLAND
BELARUS
Persian Gulf


Ishim
RUSSIA
Uralsk
Orenburg
Karachaganak
Kustanai
Omsk
Astrakhan
Aktyubinsk
Kokchetav
Novosibirsk
Kulsary
Tengiz
KAZAKHSTAN
Pavlodar
Aktau
Karaganda
Semipalatinsk
AZER.
Baku
Aral Sea
Kumkol
Ust-Kamenogorsk
Lake Balkhash
Caspian Sea
TURKMENISTAN
UZBEKISTAN
Khiva
MONGOLIA
Chimkent
Alma-Ata
Ashkhabad
Tashkent
Frunze
Chardzhou
KIRGHIZSTAN
Dushanbe
AFGHANISTAN
TAJIKISTAN
IRAN
National Capital
City
Country Borders
Existing Gas Pipeline
Planned Gas Pipeline
Gas Field
0 500 Miles
0 800 Km


PROPOSED AND EXISTING OIL AND GAS EXPORT ROUTES
UKRAINE
MOLDOVA
ROMANIA
BULGARIA
RUSSIA
KAZAKHSTAN
UZBEKISTAN
TURKMENISTAN
GEORGIA
ARMENIA
AZERBAIJAN
TURKEY
SYRIA
IRAN
IRAQ
LEBANON
JORDAN
EGYPT
SAUDI ARABIA
KUWAIT
Volgograd
Dnepropetrovsk
Odessa
Bucharest
Varna
Istanbul
Trabzon
Ankara
Ceyhan
Mosul
Kirkuk
Al Mawsil
Baghdad
An Nasiriyah
Al Basrah
Georgiyevsk
Groznyy
Tbilisi
Dogubayazit
Tabriz
Orsk
Uralsk
Karachaganak
Kenkiyak
Zhanazhol
Atyrau
Astrakhan
Kulsary
Tengiz
Aktau
Krasnovodsk
Ashkhabad
Sarakhs
Meshhed
Tehran
Qom
Kermanshah
Esfahan
Dezful
Ahvaz
0 250 Miles
0 400 Km
Port
Refinery
Commercial Hydrocarbon Field
Existing Oil Pipeline
Proposed Oil Pipeline
Existing Gas Pipeline
Gas Line Planned Or Under Construction
Existing Products Pipeline
Indication Of Proposed Oil Pipeline Route

TURKMENISTAN'S IRANIAN OPTION



SOUTH AMERICA

Background

South America has a rich, colourful and often troubled history, characterised latterly by decades of political and economic instability. Industrial development in the region has on the whole been slow, and during the mid-1980s most countries suffered a period of deep economic recession.

The continent is also rich in natural resources - in particular oil and gas. Until now oil reserves have received almost all the attention, with relatively little focus on developing gas reserves. Although gas exploration and production has been fairly low key, South America's proven gas reserves are still bigger than those of North America. South America has nearly 290 trillion cubic feet (tcf) of proven gas reserves - with the likelihood of actual reserves being far higher - while North America has just 250 tcf with less scope for major new discoveries. At the same time gas consumption in South America is much smaller than in North America. North America consumes 19-20 tcf/year while South America only consumes about 3-3½ tcf/year giving some indication of the scope for developing South American gas markets. It is generally recognised that the time has now come for South America to develop its gas reserves particularly given the profound changes taking place in the political, economic and legislative systems of South American countries.

South America is experiencing the global trend towards a democratic system of government and a market oriented economy, and in many cases the new systems are bringing with them greater stability and affluence although, admittedly, not all countries are making the transition at the same pace or with the same degree of success.

Political reform in Argentina and Chile has, however, already helped to put annual economic growth into double figures, while Mexico and Peru also seem poised for strong economic recovery in the later 1990s. Similar moves in Colombia and Bolivia, where the 1980s recession did not cut quite so deep, are expected to increase economic growth and stability. The broader view too reflects the same trend as trade barriers are dismantled to make way for an increase in regional trade between South American countries and to encourage participation in international trade. At the other end of the scale, previously state-run industries are now being privatised - including oil and gas. One of the effects of these changes is to create favourable conditions for private investment.

While the political and economic framework in South American countries is restructured perceptions of gas are changing too. New applications for gas such as power generation, natural gas vehicles and gas fired air conditioning combined with a growing environmental awareness add up to a persuasive case for better exploitation of the continent's huge resource base. Several countries see an increasingly important role for gas in their economies, not only as a fuel for industrial regeneration but also as a source of export revenue. However, in order to realise its potential the industry needs massive investment throughout the gas chain, from well head to burner tip. Some observers estimate that the investment required could be as high as $35 billion.

Chile - Trans - Andean Pipeline Project

(1) British Gas is carrying out a one year feasibility study (preliminary work on which began in January 1994) of plans to build a pipeline over the Andes to transport gas from Argentina to Chile under an agreement signed with its partners (which include Tenneco and Chilectra Metropolitan SA) in the still tentative project. The feasibility study on behalf of the project consortium has been costed at about $15 million.

The proposed natural gas project links Argentine gas supplies to new markets in Santiago and other cities in central Chile.

The project would involve building a gas distribution system totalling almost 5,000 miles for Santiago and other cities, constructing 750 miles of gas transmission pipeline from the Nuequen field in Western Argentina over the Andes to the Chilean capital, and the construction of $500 million of natural gas fired power generation facilities.

BG has already been appointed technical operator for a joint company (Gas de Chile) which will build and operate the 5000 mile $400 million grid in Chile. BG has taken a 30% interest in the joint company, in which its main partner will be the Chilean state owned power company, Chilectra (35%). Tenneco of the US, which is in a formal alliance with BG in South American gas distribution markets, has been selected as technical operator of the $600 million 500 mcfd main trunkline across the Andes. Tenneco is to take a 25% stake in the transmission company (Gasoducto Transandino) and will build and operate the line.

Current cost estimates for the entire project currently range between $1.5 billion and $1.65 billion spread over a 25 year period. Present plans for first gas to be sent through the pipeline in 1998 have been taken as a sign that the consortium hopes to start construction in 1995. However, completion of the full network is expected to take between 10 and 15 years.

(2) In October 1994 NOVA Corporation gave details of its competitor project, named Gas Andes, to that identified with Tenneco and British Gas. This initiative stems from the company's first giant step into international equity ownership in 1992 when it purchased an operating interest in the northern leg of the main Argentine pipeline.

The $300 million project would provide initial volumes of around 110 million ft/day by 1997, doubling in ten years and possibly rising to 530 million ft/day after 15 years of operation.

NOVA sister company Methamex has operated in Chile for several years and its project partner Trans Alta Utilities Corporation owns and operates two large power generating plants in the country and is looking at operating a gas-fired Santiago power plant.

NOVA would also seek to hold a stake in Chilean gas distribution.

Brazil - Bolivia to Brazil Pipeline

The Presidents of Brazil and Bolivia failed in August 1994 to agree details of a $2.0 billion gas pipeline, to be built from Bolivia's extensive fields of natural gas to Brazil's industrial south.

The pipeline will go ahead eventually but agreement on the shareholdings in the project has been delayed by negotiations over the price Brazil should pay for Bolivian gas and over the quantities it should take.

The project, which has been under discussion for years, was advanced when Petrobras, the Brazilian state owned oil and gas company, announced it had chosen the BTB consortium as the main partner for its share of the project. BTB is a joint venture of BHP, Tenneco and British Gas. It's understood, as reported by Petrobras and by YPFB of Bolivia, that full financial backing to underpin construction is in place.

The proposed 2,000 mile pipeline is a significant component in Brazil's strategy to develop an integrated natural gas project at an expected total cost of approximately $5 billion. The pipeline project now moves into the validation phase, in which the BTB Group will work with Petrobras, the project's primary sponsor, to review project specifics and undertake additional studies as needed. Subject to satisfactory completion of this feasibility work and financing confirmation construction should start in 1995 and gas should flow by 1997.

The consortium will be working with Petrobras to expand the country's natural gas infrastructure and to develop new markets for the clean burning fuel, including electric generation plants, industrial facilities and local energy consumers. With a population of 85 million, southern and south eastern Brazil account for approximately 82% of the country's aggregate industrial production and 75% of its total annual energy consumption.

The Brazilian constitution obliges Petrobras to retain control of oil and gas ventures in the country, so the company is guaranteed a 51% shareholding in the Brazilian part of the project. Petrobras wants to divide the remaining 49% among BTB, a consortium of Brazilian private companies, and Bolivia's state oil company YPFB. However, Bolivia maintains that Petrobras has acted to frustrate YPFB's wish to own all the remaining shares. Petrobras says YPFB was to hold only 4% of the shares, a claim Bolivia strongly denies confirming that it wanted 49% and that the project was a 'parity relationship'. Petrobras and BTB maintain that a significant third-country's shareholding will help raise finance for the project.

Bolivia is also thought to want to re-negotiate the price accord, signed in February 1993 seeking either a higher price for the gas or more consumption by Brazil.

Despite these high level disagreements, progress with parts of the project have continued to be monitored, as described below.

In February 1994 the contract for laying the second stage of the Rio de Janeiro - Belo Horizonte gas line was signed.

This section from Juiz de Fora to Belo Horizonte in Minas Gerais state is budgeted at $44 million and should be completed by mid 1995. Builders are Camargo Correa and Sade and

Confab has won the tender for supplying the steel pipelines. The 220 mile BEL-RIO line will allow the industrial state of Minas Gerais either to receive natural gas supplies directly from Campos Basin (off Rio de Janeiro state) or eventually from the proposed Bolivian pipeline via Sao Paulo by reversing the flow of the Rio Sao Paulo trunk gasline. Expected throughput is calculated at 600 mcf/day by end decade. Several large industries, including Fiat, in Greater Belo Horizonte are already served by a small gas network which has been primed with residual gas from the Gabriel Passos Refinery for the past three years. The first section from the Duque de Caxias refiner (Rio) to Juiz de Fora is expected to be completed on schedule by March 1995.

The in-depth feasibility study carried out by Sao Paulo consultancy Technoplan for industry association SPG showed the project needed an equity rate of return of the order of 25% to attract funds. Investigations showed that the perception of risk associated with what is an essentially greenfield energy infrastructure project in the countries of Brazil and Bolivia would require project (i.e. unleveraged), after-tax rates of return of the order of 17-18% in order to attract the required funds. With the current tax regime and expected costs of financing in Brazil this corresponds to equity rates of return of the order of 25%. Obviously, depending on the precise project structure and allocation of risks, these rates could diminish somewhat but probably not by more than two or three percentage points. It is also important to remember that the proposition is to raise the required funds on a limited recourse project finance basis, meaning that even if private investors were willing to accept lower returns this would probably cause nervousness amongst the lenders.

Foreign interest in gasline related projects, especially power projects, has been reported as encouraging. Brazilian specialists say the gasline could serve thermoelectric plants costing $4 billion. Bechtel and the banks Citicorp and Wells Fargo are said to be amongst the most enthusiastic US companies showing interest in the project. Also a figure of $13 billion has been put on gas-related industrial development throughout the area of the pipeline's influence.

Enron Development Corp, a subsidiary of Enron Corp and Yacimientos Petroliferos Fiscales Bolivianos (YPFB) have signed a memorandum of understanding indicating their agreement to form a joint venture to develop, finance, construct and operate a new pipeline for the export of Bolivian natural gas to Brazil. The agreement also covers the potential construction of a pipeline to bring gas from Peru, as well as a pipeline to export gas to Paraguay. According to the terms of the memorandum, YPFB will own 60% and Enron will own 40% of the joint venture company. (The Bolivian-Brazilian pipeline project involves the construction of an 1,100 mile pipeline from Santa Cruz, Bolivia, to Sao Paulo, Brazil, with a follow-on pipeline south to Curitiba and eventually to Porto Alegre). The estimated cost of the Bolivian portion of the pipeline is approximately $400 million (Estimates of the total project range from $1.5 billion to $2.0 billion, depending on the ultimate size of the pipeline. Once completed, the pipeline will make Bolivian gas reserves available to meet the increasing demand in Brazil).

Bolivia could eventually link some of the region's largest reserves in south-eastern Peru with Brazil and other markets through development of a Peru to Bolivia pipeline. Initial efforts are also underway to link Bolivia and its neighbour Paraguay.

Argentina

(1) Export lines under study include:

- 336 mile of transmission line (and gas laterals in Argentina) from San Jeronimo field to Brazilian states of Parana, Rio Grande de Sol and Santa Catarina. The line would terminate near Port Alegre.

- 2,020 mile pipeline from the Kampo Daran fields to Uruguay and Paraguay.

(2) Warnings have emanated from the government of appeals to international tribunals should there be any drilling in disputed Falklands waters without appropriate agreement. The likelihood of joint ventures in this area between British Gas and YPB have been reported and British Gas have confirmed that they are interested in the commercial possibilities but only when the political conditions are right.

(3) The government expects to raise $130 million - $160 million through the sale of the remaining 20% stake in Metrogas.

(4) British Gas has bought a 45% shareholding in a gas-fired power plant in Buenos Aires for $24 million. The investment in the 211 MW facility is a downstream complement to BG's 29% shareholding in Metrogas, the LDC serving 1.9 million customers in Buenos Aires.

Bolivia

(1) A pipeline to carry natural gas from Bolivia to Paraguay is under consideration, and construction could start without undue delay. No details are available about the size and capacity of the proposed pipeline, which is backed by the governments of both countries and may be completed by 1997. Neither have financing details been finalised although negotiations are underway with the Inter American Development Bank and private companies

(2) Australia's BHP has signed a deal with Bolivian state oil company YPFB and Chilean equivalent Enap to be lead developer of a 680 mile pipeline feeding gas from southern Bolivia to northern Chile and of a related power generation project. This would be the first large project for BHP's recently created BHP Power affiliate, which hope to develop natural gas in Bolivia for the project. New gas fired power plants would be the primary market.

(3) A gas pipeline connecting La Carmen to Filomena, in the Cuenca Austral region, has been started up. Glacco won the construction contract from a public tender issued by Formicruz. Formicruz has a 4% share of the project, managed by Lago Cardiel. The 7 miles length pipeline has a capacity to transport 2.5 mcf/day of gas, and can be easily duplicated.

(4) Brazilian constructor Mendes Junior is building a 132 mile gas line from Yapani to Colpa y Ramal which will act as a feeder to the proposed trunk line to Brazil.

Brazil

(1) The Brazilian government has given the go ahead for the laying of two gas pipelines totalling 115 miles in the east of Rio de Janeiro state and costing an estimated $40-$50 million. Petrobras will provide around $26 million in the form of trunk pipelines and their installation while the state government and 17 councils will finance local networks. Completion is for end 1994.

The lines will both originate near Macae using Campos Basin supplies which are already processed at nearby Cabinuas. The Macae-Cantagalo branch, budgeted at $14.6 million will be 8 inch diameter and 60 miles long and serve cement and paper works, with a potential demand of 14 mcf/day.

The Macae Campos branch will cost $11 million and be 6 inch diameter and 55 miles long and serve the ceramics and, eventually, the electric power industries.

(2) Petrobras is planning to build a new gas pipeline from the Urucu gas field in the Amazon running 600 miles east to Manaus, in Amazonas state. The gas will be used to fuel power generation. The project has an estimated cost of $104 million which Petrobras is raising through a deal with BHP, British Gas, Tenneco, Enron, Nova, Transcan and Total.

(3) Environmentalists in Nova Iguacu near Rio de Janeiro are campaigning for safeguards in construction of the Rio-Belo Horizonte gasline, planned to cross the Tingua nature reserve.

Every construction project in Brazil must present a detailed report on how it will avoid damaging environmental impact.

Although the campaign is not expected to stop the gasline, it may cause some delays.

(4) Sao Paulo state gas utility Gomgas is to lay 115 miles of gas distribution lines financed by the World Bank in Sao Paulo city; most of which will be of polythene and the rest soldered carbon steel.

(5) A gas distribution network in Juiz de Fora, Minas Gerais state is due for completion in May 1995.

(6) Gas exploration in the Jurua fields in the Amazonas state continues and feasibilities are continuing on a transmission line, if sufficient supplies are discovered. The line would connect the field with Rio de Janeiro and Minas Gerais states through a 1,860 mile system.

Columbia

(1) Columbia is making a push for gas utilisation featuring pipeline and other facility construction with expenditures reaching as much as $3,025 million by the year 2015. Gas utilisation will extend from power generation, industrial and residential to vehicle

fuel. The cost will cover mainline transportation, gas distribution, CNG fueling stations and and end-user conversion to natural gas. Ecopetrol will oversee most of the activity, but outside technology will be brought into the country, particularly from France. Pipeline construction to meet the utilisation plan will include:

(a) Enron Corp, through its Centra-gas affiliate, has signed a 15 year natural gas services contract with Colombian state oil and gas company, Ecopetrol.

As part of the contract, Enron will build, own and maintain a 357 mile 18 inch pipeline from Ballena, on the northern coast, to Barrancabermeja in the centre of the country. Cost of the project is about $190 million. Completion is expected to be late 1995. Ecopetrol will be the sole customer for transportation services and has made a 15 year commitment to pay the full cost of the initial capacity of the pipeline. Enron will provide transportation services only and will not sell gas from the pipeline.

Enron is to arrange project financing, provide project management and procurement services during construction, and management and technical services during commercial operations afterwards. The project has been approved for Overseas Private Investment Corporation (OPIC) insurance against political risks, including currency inconvertibility and expropriation of taxes in the future.

Enron intends to sub-contract pipeline construction on the project to two South American companies. One will be Promigas, reportedly Columbia's largest pipeline company. The other is Techint, one of the biggest civil works name in Argentina, where Enron was picked as the operator of the major trunkline in the south of the country when the formerly state run gas distribution network was privatised in late 1992.

Promigas will be responsible for field construction management services and will operate the pipeline, while Techint will act as the construction turnkey contractor. Speculation is that Techint, which partnered Enron in the US company's privatisation bids in Argentina, may be interested in taking an equity share in the pipeline.

Enron says that it intends to hold an interest of about 50% in the pipeline and include other equity partners in the venture. Techint, which faces an increasingly competitive bid scene at home under the Argentine government's free market reforms, is known to harbour aspirations to diversify - not least of all by doing much more business in overseas energy markets, and its most logical market is elsewhere in Latin America.

(b) 58 miles of 12 and 14 inch pipe from Vasconia to La Belleza; completion 1995.

(c) 97 miles of 10 and 12 inch pipe from Sebastopol to Medellin; in service 1995.

(d) 224 miles of 18 inch pipeline from Mariquita to Cali; completion 1995/96.

(e) Promisgas S.A. plans

- 7 mile 4 inch gas line from main gas pipeline to Montelibano
- 9 mile 3 inch gas line from main gas pipeline to Corozal
- 12 mile 4 inch gas line from main gas pipeline to Arjona
- 9 mile 4 inch gas line from Barranquilla to Puerto Colombia
- 5 mile 3 inch gas line from main gas pipeline to Galapa

(2) BP has make a huge gas find in Columbia, one of the biggest in the western world in recent years.

The find, 100 miles north east of Bogota, the capital, is estimated to have recoverable reserves of between five trillion and eight trillion cubic feet of gas and 250m barrels of condensate, a light oil. (It is more than twice the size of the Britannia field, one of the biggest in the North Sea).

BP already has interests in two major oil fields in Columbia. But Columbia does not have the infrastructure for a gas industry.

Analysts said it could be 10 years before Columbia develops the infrastructure for the industry to help relieve chronic shortages in an electricity system heavily dependent on hydro-electric power.

But it is believed the new Volcanera find could be the first of a series in a chain of gas fields stretching rather like a "necklace" in the Andes foothills. The discovery straddles two exploration blocks. BP has a 100% interest in the block where the majority of the field is believed to lie and a majority stake in neighbouring territory where the find was initially made.

Volcanera is believed to have a reservoir 650ft thick and a structure extending 15 miles by three miles.

BP is planning an extensive programme of further drilling in the Andes foothills but because of government pre-emption rights, its interest is likely to be reduced to 25%.

Colombian gas demand is forecast to grow by up to 10% a year over the next five to 10 years.

Chile

(1) Chile's activity revolves around the Argentina gas line to Santiago and the associated massive gas distribution network (described under the Trans-Andean project above, and with further background material provided in the Special Feature elsewhere in this survey).

(2) Tenneco Gas has signed an agreement to develop two natural gas power plants, one near Polpaico and one near San Isidro.

Peru

(1) Spring 1995 is expected to see completion of Peru's energy privatisation campaign. Not only will state firms vanish, but long-standing restrictions on what the private sector can and cannot do are also being swept aside. The aim has been partly to improve efficiency, but mostly to boost the energy sector so that it can make even more of a contribution to national earnings. For, along with the rest of the country's massive known mineral wealth, oil and gas development has barely scratched the surface. Overall, it is reckoned that 88% of Peru's mineral potential remains to be unlocked. Privatisation is seen as the most effective way of opening that door.

From the point of view of this survey the potentially exciting developments centre on the Aguaytia and Camisea gas fields, as set out below:

(a) Aguaytia development depends on a deal signed between Perupetro and US-based Maple Resources. The deal provides for a 30 year concession for the gas field which is thought to hold proven reserves of 225 bcf gas and 21 million barrels of NGLs.

Maple is to spend an ultimately planned $68 million partly to prove up probable reserves of 175 bcf gas and 14 million bbl NGLs. Dry gas will be used locally to some extent but most will find its way to a new power station.

At present a three-phase development is envisaged, initially involving testing. Two existing wells on Aguaytia are reckoned able to produce some 30 mcfd. This phase should take about a year, with Phase 2 occupying a similar period, dedicated to installing a gas-processing plant at Aguaytia and a pair of 56 mile pipelines to Pucallpa. One, of 6 1/2 inch diameter, will convey up to 20 mcfd of gas. The other, of 4 1/2 inch diameter, will handle 1,000 b/d of NGLs. The latter will be processed at Pucallpa refinery where propane and butane will be stored for local distribution. The local market in Pucallpa town will initially be able to absorb up to 6 mcfd of gas, the surplus being reinjected to start with

Phase 3 will see a second process plant built at Aguaytia. This will double NGL flow to Pucallpa. But, more importantly, it will provide a sizeable regular gas flow for a new power station to be built at Tingo Maria. This will require a 62 mile, 12.7 3/4 inch pipeline. Power from the station will be fed into the grid run by Electroperu (also undergoing privatisation). The advent of a new thermal power station is important since, at present, of the country's total capacity of 1,864 MW no less than 1,560 MW is based on hydroelectric power. Variable rainfall sometimes causes havoc with electricity supply and Aguaytia gas is seen as an ideal way to even out peaks and troughs.

(b) Camisea gas development previously came to nothing. The government has now signed a deal with multinational Shell which is to conduct a year-long study to determine how best to develop the three fields - Cashiari, Miapaya and San Martin.

Together these fields hold an estimated 17 tcf of gas and 850 million bbl of condensate. The original $1.3 billion 1988 plan largely foundered because of the lack of incentives in the petroleum and tax regimes. Now these obstacles have been swept aside. But whether the new plan will be along similar lines to that scrapped earlier remains to be seen. The size of the Camisea fields is such that Shell originally reckoned that only the Lima area could absorb the volumes dictated by economic production. This would have meant a pipeline across the Andes, gas initially being used for power generation. Later, local distribution would be developed for industrial and domestic consumers. The cost meant that, at oil prices less than $18/bbl, gas could not be priced to show a profit. Local authorities in the producing area wanted local gas use, both for industry and for power generation. But the volumes involved and a missing link in the national electricity grid meant that the scheme too came to nothing.

If the electricity grids can be linked, Camisea could make a sizeable contribution, at lower cost than piping gas to Lima. Aguaytia shows the way, on a much smaller scale. Now Shell, the government and the local provincial authorities all seem to be working towards a common goal. The hope is that Perupetro and Shell can sign a definite development deal by the end of 1995.

(2) In the light of item (1) above Peruvian gas pipeline projects remain on the slow track. For the record, those under consideration are:

- 364 miles of 10 to 26 inch transmission lines between Camisea and Lima
- 225 miles of 6 to 16 inch line from Camisea to Cusco
- 400 miles of 14 and 20 inch line between Yangas and Pasamayo
- 310 miles of 10 and 14 inch transmission lines from Yangas to Pisco

Uruguay

The country is moving forward with plans to build the Argentina-Uruguay natural gas line. The route would extend from the Buenos Aires area, either 26 mile or 32 mile to Colonia, Uruguay. From Colonia, the line would run 105 mile to Montevideo. Diameters would be 18 inch at Uruguay's Rio de la Plata crossing and 16 inch for the remainder of the line.

Projected capacity is 35 mcfd with increases to 105 mcfd and 141 mcfd within the following 5 to 10 years.

Venezuela

(1) Petroleos de Venezuela S.A. (PDVSA) retains under study a $48 billion development program that involves building additional pipelines and related petroleum facilities to increase crude and natural gas production. The company - unrealistically - wants the system in service in 1996.

Two proposals are being considered to export gas to Colombia. One is a 900 mile line through Venezuela to the Columbia border, and the other is a 320 mile line to connect this line with another border crossing point.

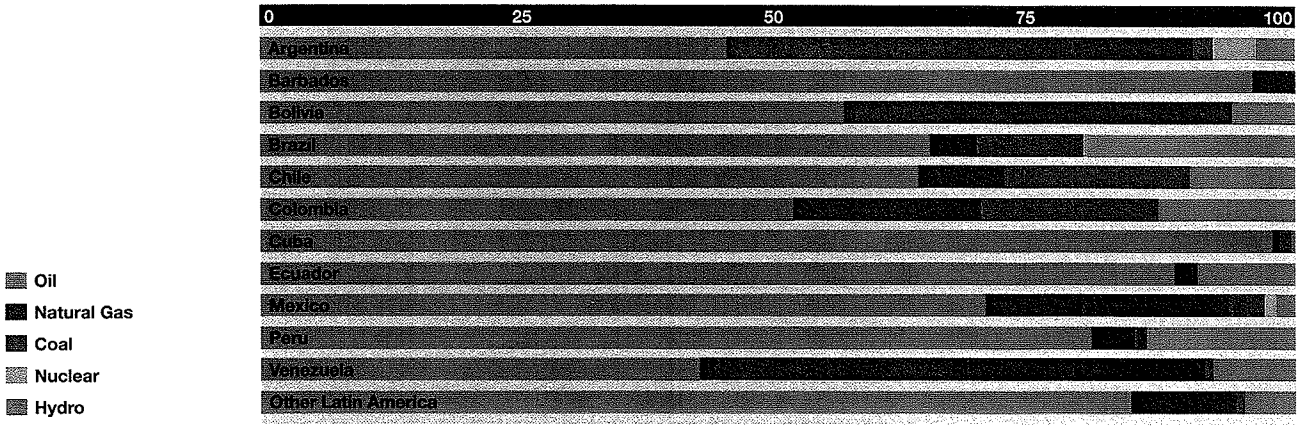
(2) Offshore, Petrohaven has a 26 mile 12 inch gas line planned from the Margarita Basin field to shore in Mapire Bay.

(3) Studies continue for a proposed $5 billion LNG export project. Gas would be supplied from four gas fields in the Caribbean Sea north of Paria Peninsula. Two lines one 30 miles and the other 20 miles would move the gas to the facility. Lagoven is leading the four company joint venture building the project with completion set for 1999 depending on construction start.

(4) Possible 2000 mile 42 inch high pressure gas line starting off the Venezuelan coast and extending from Trinidad up to the Leeward and Windward Islands through Hispanola, Cuba, Puerto Rico and the Bahamas to Miami. Earliest possible start 2010.

Primary energy fuel shares 1993

% by fuel

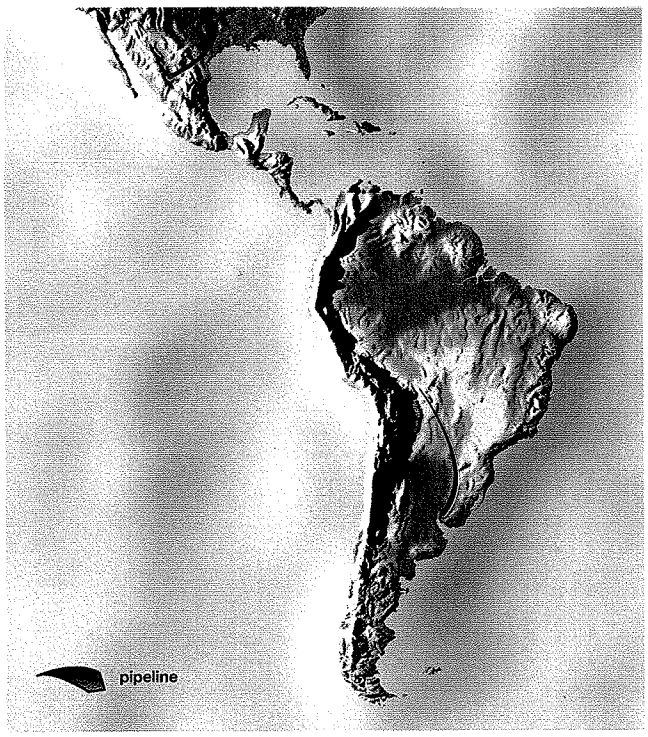


Imports by pipeline 1993

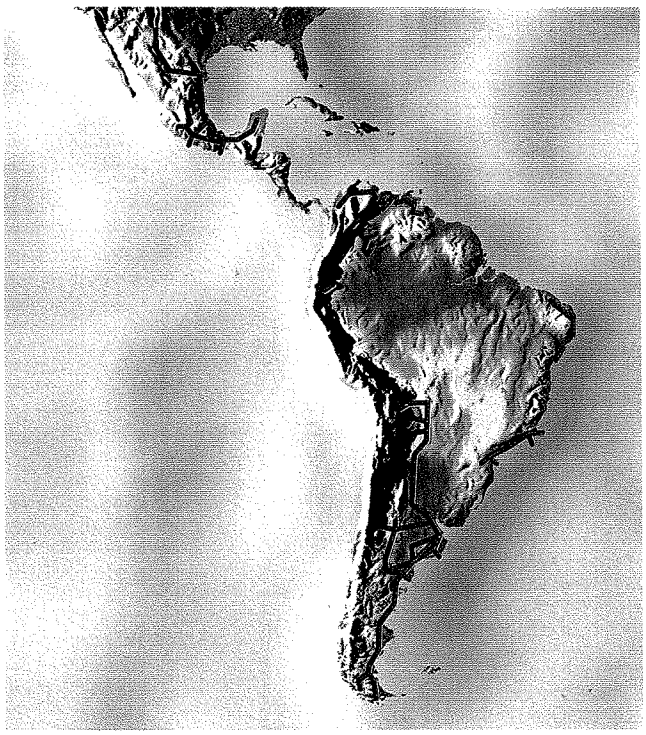
(bcm)

EXPORTER													IMPORTER
USA	Canada	Bolivia	Mexico	Denmark	Germany	N'lands	Norway	UK	FSU	Iran	Algeria	Malaysia	Total Imports
		2.23											Argentina 2.23
1.05													Mexico 1.05
1.05		2.23											

Inter country/regional trade flows

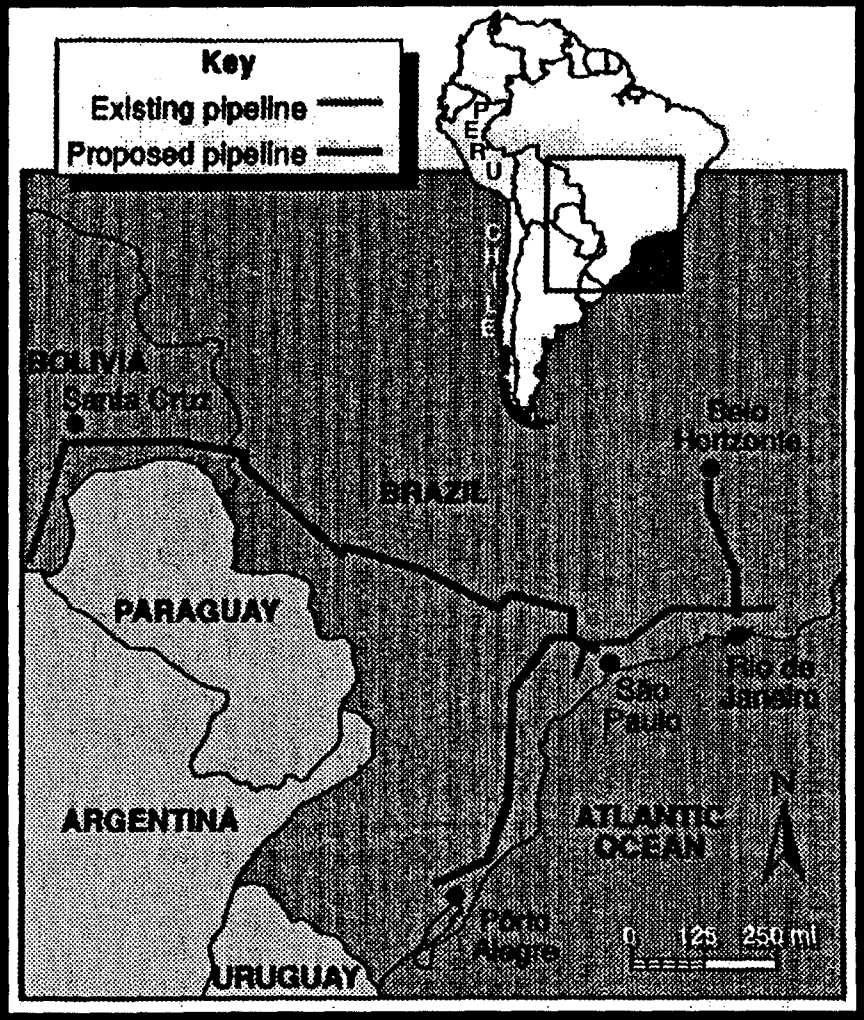


Major pipelines

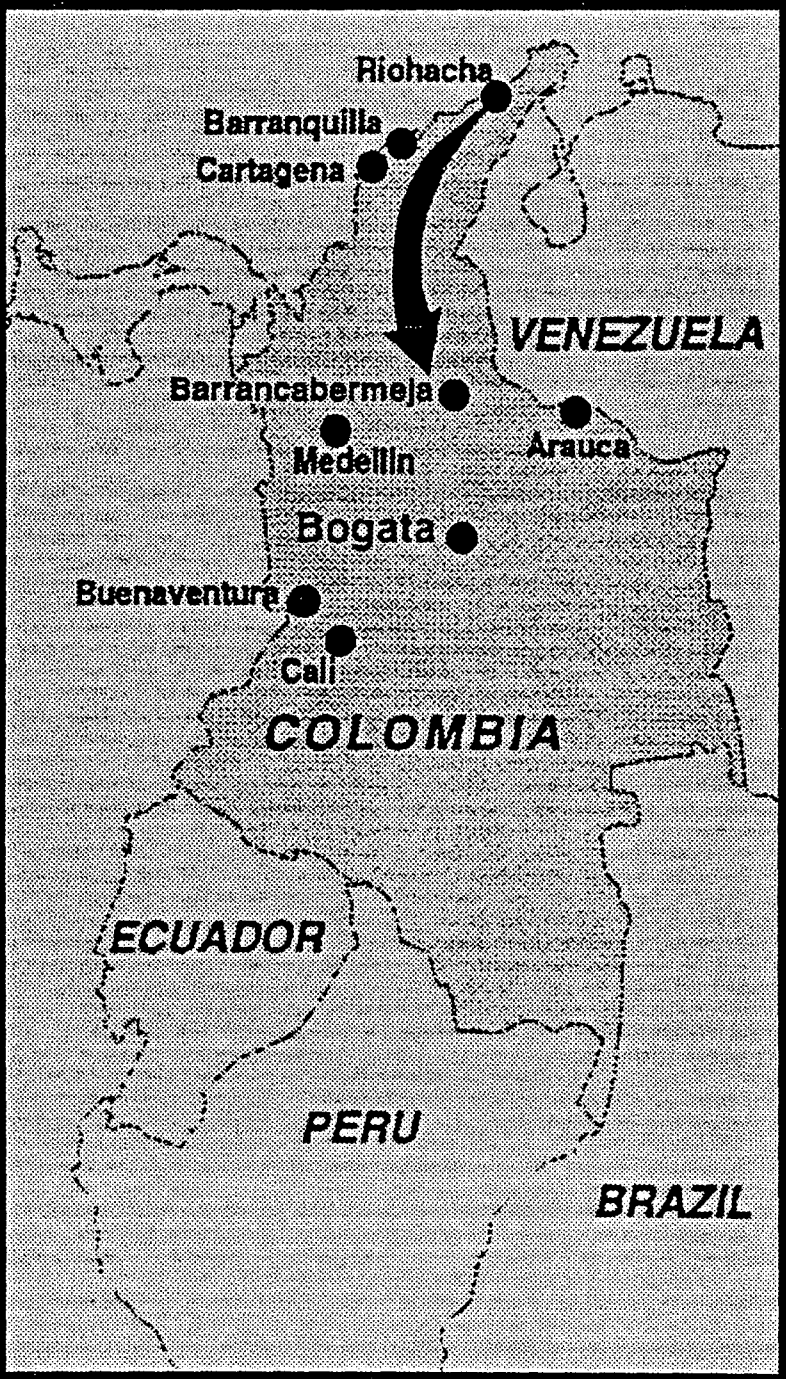


TRANSANDEAN PIPELINE

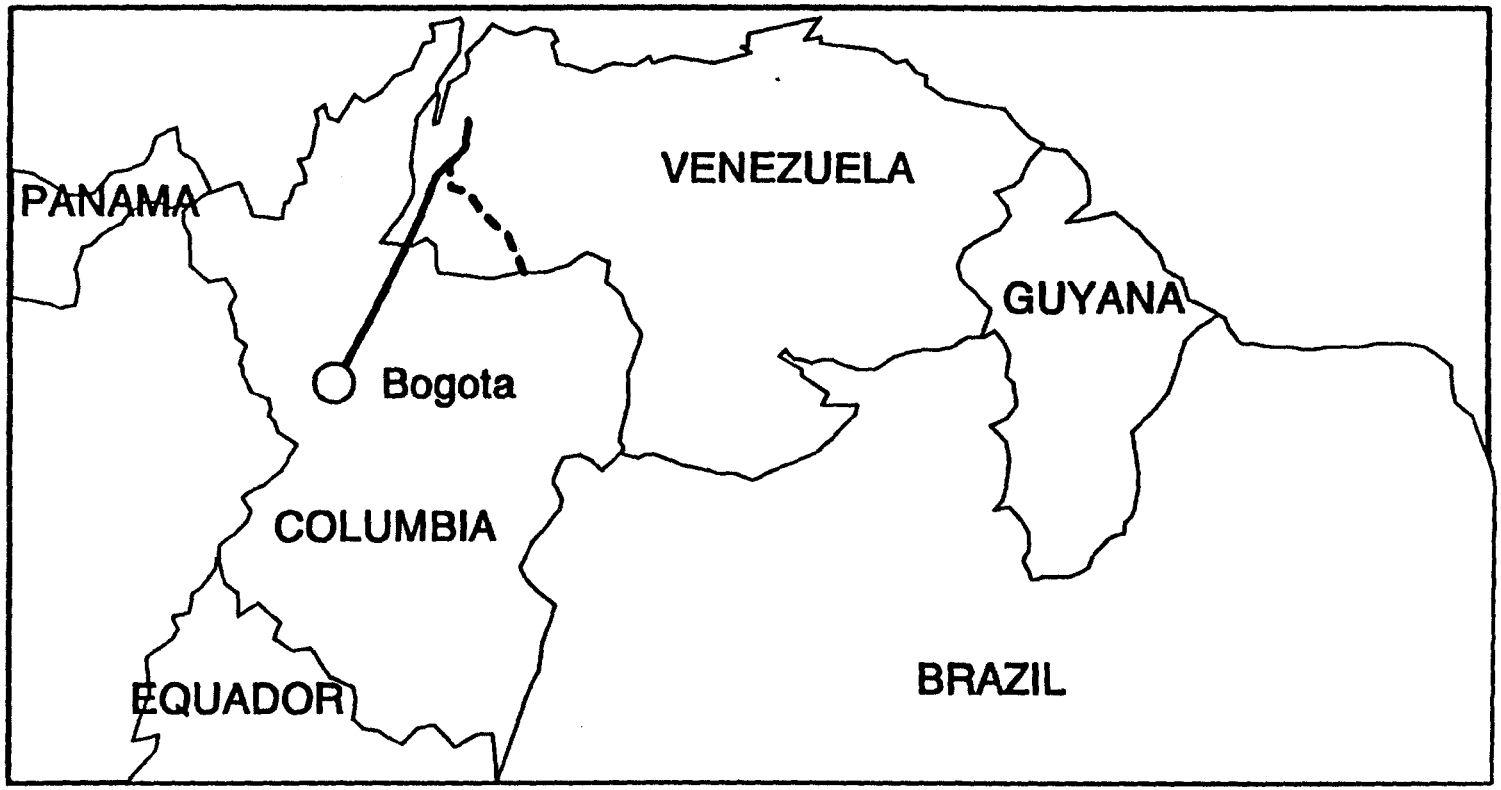
BOLIVIA - BRAZIL PIPELINE

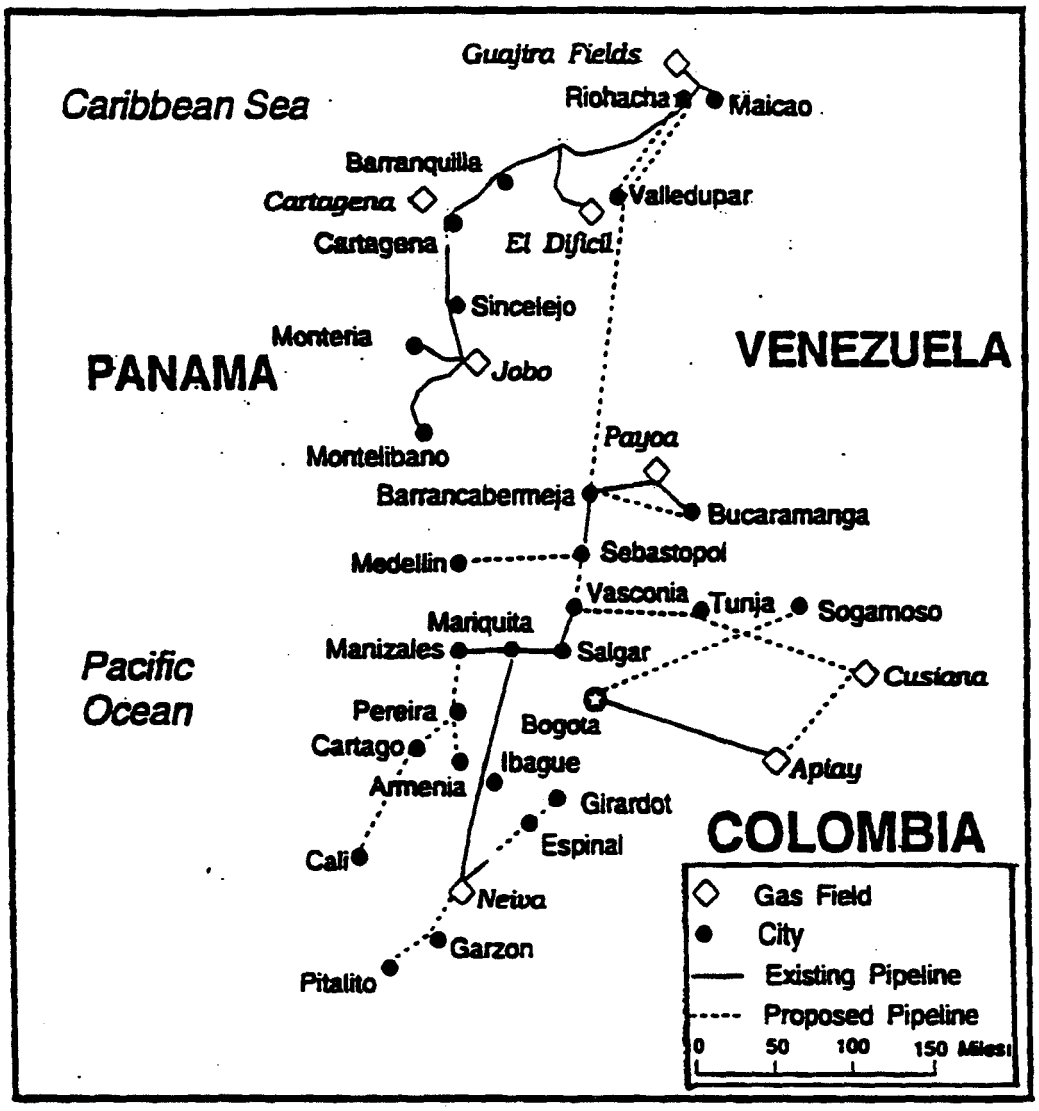


COLUMBIAN PIPELINE



VENEZUELA PIPELINES




Guajira Fields
Caribbean Sea
Riohacha
Maicao
Barranquilla
Cartagena
Cartagena
El Dificil
Valledupar
Sincelejo
Monteria
PANAMA
Jobo
VENEZUELA
Montelibano
Payoa
Barrancabermeja
Bucaramanga
Medellin
Sebastopol
Vasconia
Tunja
Sogamoso
Mariquita
Manizales
Salgar
Cusiana
Pacific
Ocean
Pereira
Bogota
Cartago
Ibague
Aptay
Armenia
Girardot
COLOMBIA
Espinal
Cali
Neiva
Garzon
Pitalito
Gas Field
City
Existing Pipeline
Proposed Pipeline
0
50
100
150 Miles

THE PACIFIC RIM

Background

European, North American and Australian pipeline companies are busy building pipelines to transport natural gas to power stations throughout the countries of the Pacific Rim, especially those in South East Asia. Many countries, such as Thailand, Malaysia, Singapore and Indonesia, have economies expanding at more than 8% a year. Cambodia and Laos are awaiting energy development. Myanmar will not only benefit from the global economic expansion but from the flourishing economies of nearby Thailand and Malaysia which are now investing in neighbouring countries, while their national petroleum companies are starting to operate worldwide. It is the ever expanding rush of industrialisation, urbanisation and the move to raise living standards throughout the region that is accelerating the need for more power stations, both gas and coal fired, throughout South East Asia.

The South Pacific - Australia and New Zealand - has an aggressive gas pipeline prospect that offers some 6,500 miles of new development. In particular, Australia's future plans involve a number of planned projects that eventually will develop into a national gas grid. The overall objective is to establish competitive energy prices.

Thailand

(1) The European Investment Bank (EIB) is providing a $46 million loan in Thailand. The loan goes to the Petroleum Authority of Thailand (PTT) for the construction of a new parallel 264 mile 36 in gas pipeline from the Erawan gasfield in the Gulf of Thailand to the Ma-Ta-Pud; and thence to the existing grid at Bang Pakong, 50 miles from Bangkok. This project is of particular interest as it will enhance the achievement of environmental benefits. Fuel oil or coal will be replaced by gas, in particular to produce electricity under circumstances less harmful to air quality. Transmission capacity will increase from 800 mcf/day to 1200 mcf/day.

The $670 million project co-financed with the World Bank ($154 million) the Asian Development Bank ($100 million) and the Exim Bank of Japan ($100 million), responds to the Thai Government's overall strategy for the development of the energy sector, a bottle-neck for the booming economy. Major European oil companies are involved in exploration and production in the Gulf of Thailand where British Gas reports that the Bangkot gas field has proved more successful than anticipated.

At the same time it is understood that the Belgian leading steel cord and wire maker Bekaert NV has won a contract to supply the framework (8,000 tonnes of lattice work) for the gas pipelines, the precise value of which has not been revealed but is likely to amount to about $100 million.

The onshore section will run about 70 miles from Ma-Ta-Pud to Bangkok. Bechtel is consultant for this project which is scheduled for completion in 1996.

(2) The Petroleum Authority of Thailand (PTT), with the endorsement of its board of directors, is to implement a $140 gas ring project to supply natural gas through pipelines to factories and a new power station at Ayutthaya near Bangkok. Final government approval is awaited.

The implement follows a feasibility study conducted by Tractebel of Belgium which shows that the demand for natural gas of factories in Bangkok and nearby provinces will increase from 134.4m cubic feet per day in 1991 to 183.7m in 1995, 250.5m in 2000 and 304.8m in 2006.

The power station project calls for a new 28 inch line, about 62 miles long, to be laid from Bang Pakong in Chachoengsao, branching out from PTT's trunk on/offshore line, to Wang Noi in Ayutthaya where the Electricity Generating Authority of Thailand (Egat) will build the 1,200 MW combined cycle plant. According to PTT officials, the line would be capable of delivering 500 mcf/day of gas.

Laying was expected to start in October 1994 for completion in 1995 when the initial phase of the Wang Noi plant comes onstream. In fact the pipeline project was being implemented ahead of its August 1995 planned schedule because Egat had brought forward the Wang Noi plant scheme in lieu of other delayed electrification projects. About 75% of investment required for the project will come from loans, the majority from local sources, with the remaining 25% from PTT's own equity.

(3) It is reported that PTT also plans to move forward with laying a 242 mile 24in line from Esso's Nam Phong field to join an existing line between Bangkok and Saraburi, and, to connect Khonkaen and Chou Buri provinces with a new 437 mile 24in - 18in line.

(4) Thailand's petroleum authority has started operations on its 100 mile 24in pipe line connecting offshore gas fields with power generation plant in Khanom. Gas is supplied from the Erawan gas field operated by Unocal Thailand.

(5) Other pipeline projects include a Surat Thani Bangkok connection and a Vietnam - Thailand link, both still in the concept stage.

Myanmar (Burma)

The governments of Thailand and Myanmar (formerly Burma) have agreed on the route for a proposed $600 million pipeline to deliver gas from Myanmar's Gulf of Matarban to Bangkok via Aurat Thani. The route will pass from the Andaman Sea through Burmese territory populated by Mon and Karen ethnic minorities to Thailand. The Yadana field, which is scheduled to come on stream in 1998, is operated by Total in partnership with Unocal, both of which produce gas in Thailand as well. The Petroleum Authority of Thailand (PTT) aims to acquire a 30% interest in the field through its upstream unit, PTT Exploration and Production.

Total and Unocal will jointly build the pipeline, on which construction is to begin in 1995 for completion in 1998. Throughput capacity has been set at an initial 240 mcf/day rising to 600 mcf/day at a later stage.

The project, as currently envisaged, will include a 250 mile subsea section and a further 62 mile stretch onshore extended by a further 24 miles to deliver gas to a planned 2,100 MW combined cycle power plan south east of Bankok. Onshore/offshore compression facilities and an onshore receiving terminal will be needed.

The sale of natural gas from the Gulf of Maturban fields, where reserves are estimated at between three and four tcf has been agreed by PTT and Rangoon authorities.

However, there are serious political difficulties associated with the pipeline in Burma where opposition groups have campaigned against it on the grounds that it would provide revenue for the junta that came to power in 1988 after crushing a pro-democracy uprising. Autonomy-seeking Karen guerrillas, who operate in southeast Burma (through which the line is to be routed) have warned that the facility is vulnerable to attack and have threatened to blow it up. Unless the Burmese junta reaches a cease-fire with the rebels it is expected to send troops to clear the route for the pipeline.

Thailand has put heavy pressure on the ethnic minorities along its border to reach peace deals with Rangoon, but there has been little progress in negotiations with the Mon and the Karen.

Malaysia

(1) The core of the country's national energy policy is to displace oil with gas as the fuel for power generation in southern and western sections. Final stages of this program - Malaysia's Peninsula Gas Utilisation (PGU) project connecting gas fields offshore Terenganu to markets all over Peninsular Malaysia and Singapore of which Phases I and II (see 2 below) are completed - are now under construction via a 398 mile line starting at Meru in Klang, Selangor and extending to Bukit Keteri in Perlis. These and lateral spurs are projected to become part of the Trans-ASEAN system if this returns to favour. See (3) below for more details.

(2) PGU I and II involved the construction of 480 miles of pipeline southwards from Paka/Kertih to Kuantan, Segamat, Johor Baru and Singapore. From Segamat the line branched westwards to Port Dickson and Port Klang. In 1992 a subsea pipeline was laid from the south of Malaysia to Singapore.

(3) The PGU III project which is divided into three sectors, involves the construction of 398 miles of gas pipeline from Meru, Klang to Padang Besar, Perlis. Laterals will reach to Bukit Kaya/Hitam and Yan in Kedah, Pari in Penang and Lumut in Perak.

Petronas Gas, a wholly-owned subsidiary of Petronas, awarded two contracts worth $75.8 million to two consortiums of companies in April 1994. The first contract worth $50 million was awarded to Shapadu Energy and Engineering (SEE) and Confab Industrial SA of Brazil. It was for the supply, delivery, coating and storage of 124 miles of gas pipeline for Sector I of PGU III , which will stretch from Meru, Klang on the westcoast to Lumut, Perak. Construction began in the middle of 1994 and is scheduled to be completed by the end of 1995.

Sector 2 involves the construction of a 117 mile pipeline from Lumit to Gurun, Kedah, while Sector 3 involves the construction of a 78 mile pipeline from Gurun to Padang Besar. The whole of the PGU III is expected to be completed in 1997 and discussions continue with Thailand on the possibility of extending the PGU III pipeline to the neighbouring country.

For the first contract SEE will have a 35% interest in the venture, while the remaining 65% interest will be owned by Confab. Confab, which has also been involved in the PGU II is a manufacturer of capital goods. It is also one of the largest private companies in Brazil.

The second contract, worth $25.8 million was awarded by Petronas Gas to Tokyo Engineering Corp, Equator Engineering and Tokyo Engineering and Construction. It was for the engineering, procurement, construction and commissioning of the second dew point control unit (DPCU-2), which will serve as a back-up unit for the existing three gas processing plants (GPPs) in Kertih, Terengganu. This will ensure that there is security of gas supplies to the customers. The DPCU-2 has the capacity to process 250 mcf/day natural gas. Construction of the DPCU-2 began in mid 1994 and is scheduled to be completed by September 1995.

It is also to be noted that Saipem (jointly involved in PGU III with Petronas and Peremba Construction) is mobilising equipment from a base in Thailand. Socotherm is moving equipment in from Thailand to handle 70% of the pipecoating work while Bredero Price has established a yard in the country to deal with the remainder.

(4) Work on the second phase of the Natural Gas Distribution System (NGDS) by Gas Malaysia Sdn Bhd began in 1994 and is scheduled to be completed by 1998. It will cover Kuala Lumpur, Petaling Jaya and Bagi in Selangor, and Kluang and Johor Baru in Johor with the emphasis on residential customers. The financing facility for this project totals $147 million. For the residential market, Gas Malaysia is focusing on setting up gas pipelines to new condominiums and housing estates being built in the Klang Valley, Johor and Shah Alam. The work will involve 105 miles of pipelines which will be financed by the above loan.

The facility is provided by the Exim Bank of Japan and a group of 11 Malaysian financial institutions. The Japanese will provide a bank guarantee of $76 million, while the Malaysians will come up with the remaining $70 million to be divided into a floating rate term loan of $35 million and revolving credit of $35 million.

The $147 million loan will only finance up to 27% of the entire project estimated to cost $504 million to $581 million. The remaining 73% will be obtained through internally generated funds. Some commentators have put the total project cost as high as over $700 million.

About $136 million will be spent by 1997/8. By the time the project is completed in 20 years, 3000 miles of pipelines would have been laid, supplying gas to 300,000 customers, of which 3,000 will be industrial and commercial users.

Gas Malaysia Sdn Bhd is made up of the Malaysian Mining Corp-Shapadu Consortium, with 55% equity, the Tokyo Gas Mitsui Consortium (25%) and Petronas (20%).

(5) Offshore Pipelines Inc, joint venture company, TL Offshore Sdn. Bhd, with Renong Berhad is to lay 255 miles of gas line offshore Sarawak, Malaysia. Work involves pipelaying between four platforms including a 101 mile 38in line from MLNG and EIIR-B. Dual 36in pipelines will reach 75 miles from the offshore platforms in the South China Sea to onshore facilities at Bintulu.

(6) JP Kenny has been awarded the conceptual engineering contract for a new Malaysian gas pipeline. The export line will connect the Jintan field to Bintulu in Sarawak, Malaysia.

Indonesia

(1) Indonesian government gas company Perum Gas Negara plans to build four new 24in-30in gas pipelines worth $1 billion to increase its sales of gas to Sumatra, Java and Sulawesi. Their total length will be 1440 miles.

(a) Construction on the first 530 mile line, to connect the Asamera gasfield in central Sumatra with a Caltex oil field in Riau and Batam Island, will begin in 1996. The project will receive $430 million towards its completion from the Asian Development Bank (ADB).

(b) The second 300 mile line will connect a South Sumatra gas field run by state oil company Pertamina with Cilegon in West Java for both electricity generation and industrial use. Construction will begin in 1998. This line will be funded by a $300 million loan from the World Bank.

(c) A further 260 mile gasline will be installed in West Java to increase access and sales from offshore fields. Estimated cost of this line presently stands at $115 million.

(d) The fourth, 170 mile line will transport gas from Sengkang gas field to Ujungpandang in South Sulawesi. This will be funded by an $84 million loan from the World Bank.

In addition to these projects Perum Gas plans to extend its present pipeline network in East Java by 172 miles. Estimated cost for this expansion is $110 million. Gascor Consulting Int. is project engineer for a 155 mile 6in-16in line which will have five pressure reducing stations, 27 meter and regulator stations, and cross 200 river, canal, rail and road points.

(2) Developments outline in (1) above include Stage II of the Trans Java gas pipeline system: 413 miles of line which represents most of Indonesia's section of the Trans ASEAN system.

Work continues on Stage I of this development which is being built by a joint venture of Nippon Steel and Samitomo Corp and covers 230 miles offshore and 37 miles onshore.

Work, under the control of the Trans Java Consortium, runs a 230 mile submarine line from Pagerungan Island to Gresik in East Java of Indonesia to transport natural gas for various customers. The Pipeline Consortium grouping three national and six foreign companies will invest $460 million. The six foreign companies would invest about $300 million, while the rest would be supplied by the three Indonesian companies including PT Bimantara. The project would supply about 400 million cubic feet of natural gas per day, part of which would be consumed by the state-owned electricity company, petrochemical company and the state gas company. The natural gas to be funnelled through the pipeline would come from a gas field off the coast of Maura island that began to be developed in June 1992 by the US oil company ARCO.

(3) Shell Overseas Investment, a joint venture of Citra, C Itoh, Mitsubishi Corp, and Bimantana, has planned a $2.5 billion, 280 mile gas line connecting central Java with a petrochemical complex to be built on the southern coast near Cilacap. Completion is projected for 1995/6.

Philippines

(1) The Philippines has yet to develop a domestic gas infrastructure. There are plans to exploit offshore gas reserves to provide piped gas to Luzon, and exploration for gas has been encouraging in northern Cebu. The Philippines was one of the prospective recipients of piped gas under the earlier-proposed gas grid for Southeast Asia, shelved by the Asean Council of Petroleum in October 1990 on grounds of cost, but since reportedly under study by European Community experts. The Philippines section of the network included 276 miles of offshore and 472 miles of onshore pipes to serve all of the islands. In November 1994 it was announced that British Gas had signed a $2 billion infrastructure agreement with First Philippine Holdings Corp. which covered a number of natural gas projects in the Philippines (see (5) below).

(2) For some time the Philippines government has been considering laying a 310 mile submarine line from Malampaya field offshore to move gas to Batangas on the island of Luzon at an estimated cost of $1 billion. A decision whether to proceed with the scheme is expected to be made after Shell Exploration Philippines, operator, completes its appraisal in late 1994. The consortium of Shell and Occidental Petroleum Philippines said in late 1993 that it planned to exploit Camago - Malampaya gas and oil reserves off Northwest Palawan in the central Philippines by 1998. But it would carry out a back-to-back two-well appraisal programme to determine recoverable reserves more accurately. Negotiations towards a 25 year supply deal were under way with National Power of the Philippines.

Development costs for Malampaya have been estimated at $2 billion and reserves conjectured at up to 4 tcf. The government has in mind that Philippine National Oil Company (PNOC) would lay a line and create onshore facilities for handling gas, to be used in power stations. The country has been suffering an acute shortage of electricity. There is confidence that PNOC can raise the money needed for the scheme but

alternatively there could be a joint venture with Shell and Occidental. The companies are understood to have had in mind their own line but this could be overtaken by a government sponsored project as the state has a controlling interest in Malampaya.

(3) Meanwhile, a group headed by Kirkland Resources is understood to be studying whether to exercise an option to sink a second well after a first on Discovery Bank prospect proved dry. Through a tie-in with Dragon Oil the group has licences to drill up to seven wells in the Philippines and Thailand this year. When the group was formed in early 1993 to look again at the Linapacan A1 and B1 1982 gas finds off Palawan, the prospect of the new trunkline to move Malampaya gas was cited as a reason for interest in the area.

(4) With the backing of the Philippines government, Trans Energ of France is to carry out a feasibility study towards an LNG receiving terminal on Luzon. Trans Energ, which has the right to transfer technology to developing states, is made up of Elf Aquitaine, Gaz de France, Electricite de France and Beicip. Studies will cover LNG markets in the Philippines and tanker requirements.

(5) First Philippine Holdings Corp (FPHC) and British Gas plc, have signed a Memorandum of Understanding (MOU) to pursue a number of natural gas projects in the Philippines. The projects will be part of the vital downstream efforts to ensure a market for Shell/Occidental's Malampaya-Camago gas discovery.

The Projects covered by the MOU could include the construction of an onshore gas transmission pipeline, a series of combined-cycle power plants and eventually a distribution network for gas to industrial and commercial users. Investments in these areas are expected to reach between $1.5 billion and $2.0 billion over the next six years.

The preliminary results of a three month joint study indicated that the joint venture should build new gas-fired combined-cycle power plants along the Batangas-Manila corridor as well as consider conversion of National Power Corporation's (the Philippines electricity generation and transmission utility) old existing oil-fired plants at Sucat and Tegen. The consortium intends to propose to government the advantages of converting the Sucat and Tegen plants to higher efficiency, more reliable combined-cycle plants running on natural gas, a more environmentally friendly fuel than the Bunker-C fuel oil currently in use. It is anticipated that a substantial proportion of the electricity generated by this gas-fired capacity will be purchased by Meralco, the largest electricity distribution company in the Philippines.

To fuel the new as well as converted power plants the consortium proposes building a $150 million to $200 million pipeline that will transmit natural gas from the town of Batangas onwards to Manila with the option of branching out to Bataan should the conversion of the Bataan Nuclear Plant and Limay power plants to natural gas prove feasible. FPHC already runs an oil pipeline supplying industrial fuel oil to Sucat, and part or all of this existing line might be converted to transport natural gas to form the core of this network.

Singapore

(1) McConnell Dowell South East Asia Pte Ltd. is underway on a contract to build Singapore's first gas transmission project. The system requires 43 miles of 24in pipeline and is expected to cost $34.1 million.

(2) Construction started in summer 1994 at the Senoka Power Station located on the Johor Strait north of the island. The routing follows an existing road network to Queenstown, Toh Tuck and Kallang districts in the south. Gas will come from Malaysia through the Peninsula system. Public Utilities Board of Singapore awarded the contract which will take two years to complete.

SOUTH PACIFIC

Australia

(1) **Goldfields Gas Transmission Project**. Participants in the $291 million Goldfields Gas Transmission project in Western Australia have submitted final proposals to the state government, amid indications that the project will probably gain final ministerial approval in late-January 1995.

The project involves building a 980 mile gas pipeline from Karratha, near Port Hedland, through the Eastern Goldfields to Kalgoorlie. This would be used to transport gas from the offshore fields to the mining area, and to power projects *en route*. The participants in the venture are Western Mining's Westminco Oil subsidiary, Normandy Pipelines, which is part of Normandy Poseidon, and BHP Minerals.

As part of the scheme, BHP plans to use a spur line to carry gas to a newly-constructed power station that will supply its iron ore operations in Newman. This would eliminate the need for an overhead electricity transmission line from the Port Hedland power station to the WA town.

If the project gets the final go-ahead by end-January, it is anticipated that the first gas deliveries should take place in the second half of 1996 to the Goldfields, with Newman coming on stream slightly earlier. The pipeline was expected to provide energy savings of anything from 15 to 50% to companies using the gas to power operations and make downstream processing in the region more competitive. The consortium members would be main users of the line but an agreement with the Western Australian government provides open third-party access for a fee, allowing suppliers to negotiate deals with customers.

(2) The Pipeline Authority of South Australia expects completion in March 1995 of its 144 mile, 4in. $7 million McConnell Dowell constructed natural gas transmission line including 135 hp of compression in the Riverland area of South Australia from Angaston due east to Berri with a lateral line south to Murray Bridge. Sagasco Resources Ltd. will fund and own the line. Other Authority plans include:

(a) 800 miles of 14in line from Palm Valley to the South Australia pipe line. The line, including some 2,000 hp, could be in service late 1997 and cost $207 million.

(b) 750 miles of 14in line from the Northwest Territory into South Australia

(c) 200 miles of 4in or 6in line in the Roxby Downs area

(d) 375 miles of 12in line in the Minerva area.

(3) Canberra-based government owned Pipelines Authority is moving ahead on construction of the 870 mile 8in ethane pipeline from Moomba in north South Australia to Sydney, being built for ICI Australia Ltd. by East Australian Pipeline Ltd with a target completion date of 1996.

The authority called for tenders back in March 1994 for the first two 300 mile sections, together with line pipe and joint coating. Tenders for the third and fourth sections which enter the built up areas around Sydney were also called. As well as the pipeline the project includes a 1,000- hp station at Moomba and a 1,200 - hp station at Bulla Park. Value $134 million.

The authority had hoped to start construction in July 1994 but an ethane contract between Cooper Basin gas producers and ICI had still to be finalised thus causing delay in the pipeline construction schedules.

The ethane is needed for ICI's ethylene plant at Botany, Sydney. The company has been talking to gas suppliers in South Australia on the viability of the project which the company would be capable of financing internally However, it needs to look to see whether the bulk chemicals business it has traditionally been involved in will be competitive for reinvestment by 2000 or whether Australia would be better suited to biotechnology.

Meanwhile, Nova Corp. and Malaysian state oil and gas company Petronas have won Australian Foreign Investment Review Board approval for their participation (25% and 24% respectively) in the Moomba-Sydney gasline project at a combined cost of $354 million. The 808 mile 34in line stretches from the Cooper Basin to the Australian Gas Light Company's distribution system in Sydney. AGL will still own 51%. The sale is part of the strategy to privatise parts of the gas pipeline system

(4) Gas projects in Queensland include the following:

(a) Twenty-two organisations including a number from overseas, answered the Queensland government's invitation of private sector interest in financing, construction and operation of a 500 mile gas pipeline from SW Queensland gas fields to Roma to tie in to the existing natural gas line to Brisbane.

The Queensland government is set to identify organisations with capacity to undertake development of both the line and the market for consumers.

Additional gas supply arrangements need to be in place by 1996. Cost of the line is put at $145.6 million. Adelaide based Santos Ltd has had the line under study for some time and has been looking at several options, including conversion of the Jackson-Moonie oil pipeline to gas.

(b) Agreements have been reached on transporting Queensland gas to South Australia. The primary route reaches 124 miles from undeveloped gas fields in Cooper and Eromanga Basins to the Moomba gas processing complex in northeast South Australia

(c) Oil and Co of Queensland is considering a 100 mile gas line from Denison Trough to Roma.

(5) The Gas and Fuel Corp of Victoria may not be privatised for at least three years, according to its management. Timing and form of privatisation would depend on the dramatic changes sweeping Australia's natural gas industry and progress in modifying the industry's regulatory framework in Victoria. A first step was likely to be the sale of Victoria's high pressure gas pipeline network. An important element in freeing up gas trade within states and across state boundaries was elimination of restricted gas access to networks.

This process began with sale of the Moomba-Sydney pipeline to an AGL-led consortium (see at 3 above). Predicted Victoria gas demand is likely to exceed its existing supply contracts by the middle of the next decade. Suppliers would require access to the pipeline network earlier so as to allow development of new fields. This offers hope to BHP Petroleum which is now studying options for the new Otway Basin Minerva field find 6 miles offshore Port Campbell in western Victoria. Gas from Minerva may be fed into the Adelaide market, boosting supplies in South Australia and allowing gas in central Australia and Queensland to be diverted to growing markets in NSW and Queensland.

(6) A 205 mile natural gas pipeline to be built by McMahon Holdings Ltd and Advanced Pipeline Technology will fire a power station to be built by Energy Development Ltd (EDL) at the new McArthur River zinc-lead mine in the remote Gulf of Carpentaria region. The gasline spur will join the Alice Springs-Darwin main trunkline at Daly Waters, 370 miles south of Darwin and travel 205 miles east to the mine site 37 miles south of the town of Borroloola. EDL won the contract to build and operate a 22 MW station at MIM Holdings Ltd's ($183 million) mine development at McArthur River.

EDL has operated a 16 MW gas-fired power station at Pine Creek, south of Darwin, for several years, also fed by the Alice Springs-Darwin gasline. The Northern Territory government was to upgrade the Pine Creek station. EDL plans to relocate three of the existing electricity generating sets from Pine Creek to McArthur River where three additional units will also be built. At Pine Creek EDL will use two 10 MW gas turbines and one 6 MW steam turbine to generate 25 MW of electricity, forming an integral part of the NT's baseload requirements under a 20 year contract with the Power and Water Authority.

(7) Pipeline projects being planned or under consideration include:

(a) Elf Aquitaine & Partners are moving ahead with a $2.8 billion, 183 mile transmission line and LNG plant.

The line would extend from the offshore Tern and Petrel fields 115 mile to an onshore station at Bonaporte and another 68 mile to Darwin.

(b) West Australia Petroleum Co has plans to lay 80 mile line from the Gorgon gas field to the Karratha Woodside LNG facility. Plans involve a multi-billion dollar system extending offshore from the western coast of Western Australia to a point 37 mile south of the North Rankin platform.

(c) Australian Department of Resources and Energy is studying a 3,000 mile large diameter trans-continental gas line.

(d) East Australian Pipeline Ltd is studying a 82 mile 12in line from Albury to Wagga Wagga Burnt Creek to Junee in New South Wales.

(e) Magellan Petroleum Australia Ltd is planning a 375 mile transmission line in the Northern Territory from Gove to Darwin.

(f) Woodside Petroleum Development, Ltd is planning a 22 mile, 30 in. line from the north Rankin field and 118 mile 14 in. and 10 in. lateral from Dampier to Pibras.

(g) Esso Expro Australia and BHP Petroleum plan to install a dual 28 mile line from Bass Strait fields to Longford, Victoria.

(h) Northern Territory's Power and Water Authority is studying a 367 mile 12in. gas line from Mataranka to Gove.

(i) Santos Ltd plans to build a 70 mile 4in-14in gas gathering system at Cooper Basin.

NEW ZEALAND

(1) The gas pipeline project for the Kupe oil and gas field 22 miles offshore in the Taranaki Bight is expected to open for bidding in 1995. Western Mining Corp (NZ) Ltd's development plan involves study of both gas and oil pipelines to shore. Securing of appropriate gas contracts will initiate field development. Production could start sometime in 1997.

(2) The Ministry of Energy plans to fuel the Marseden power station with gas and is considering a 145 mile, 12-20in. pipeline system on North Island from Huntly to the station site near Whangare.

(3) Southgas Resources plans for South Island:

- 62 mile gas line in the Invercargill area

- 112 mile gas line in the Dunedin area

(4) Shell BP and Total Oil Services proposes the following gas lines:

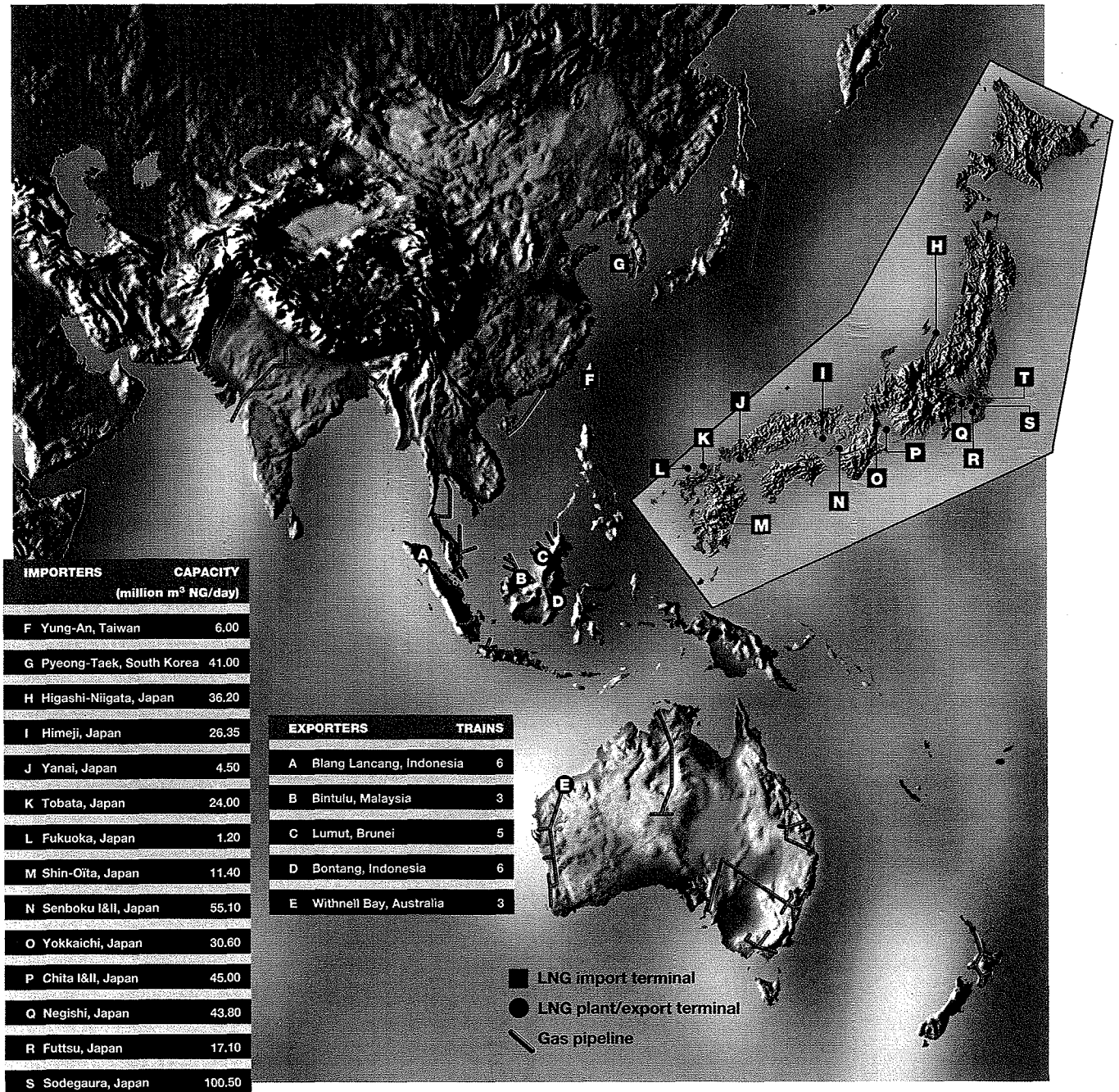
- dual 19 miles of 24in. lines from Maui field to shore
- 276 miles of offshore line from Maui B platform to Taranaki.

Imports by ship 1993

(bcm)

EXPORTER								IMPORTER
USA	UAE	Algeria	Libya	Australia	Brunei	Indonesia	Malaysia	Total Imports
1.41	3.35			6.58	7.47	24.13	10.09	Japan 53.03
				0.07	0.07	5.48	0.38	South Korea 6.00
						2.32		Taiwan 2.32
1.41	3.35			6.65	7.54	31.93	10.47	

Major pipelines and LNG terminals



IMPORTERS	CAPACITY (million m³ NG/day)
F Yung-An, Taiwan	6.00
G Pyeong-Taek, South Korea	41.00
H Higashi-Niigata, Japan	36.20
I Himeji, Japan	26.35
J Yanai, Japan	4.50
K Tobata, Japan	24.00
L Fukuoka, Japan	1.20
M Shin-Oïta, Japan	11.40
N Senboku I&II, Japan	55.10
O Yokkaichi, Japan	30.60
P Chita I&II, Japan	45.00
Q Negishi, Japan	43.80
R Futtsu, Japan	17.10
S Sodegaura, Japan	100.50
T Higashi-Ohgishima, Japan	30.80

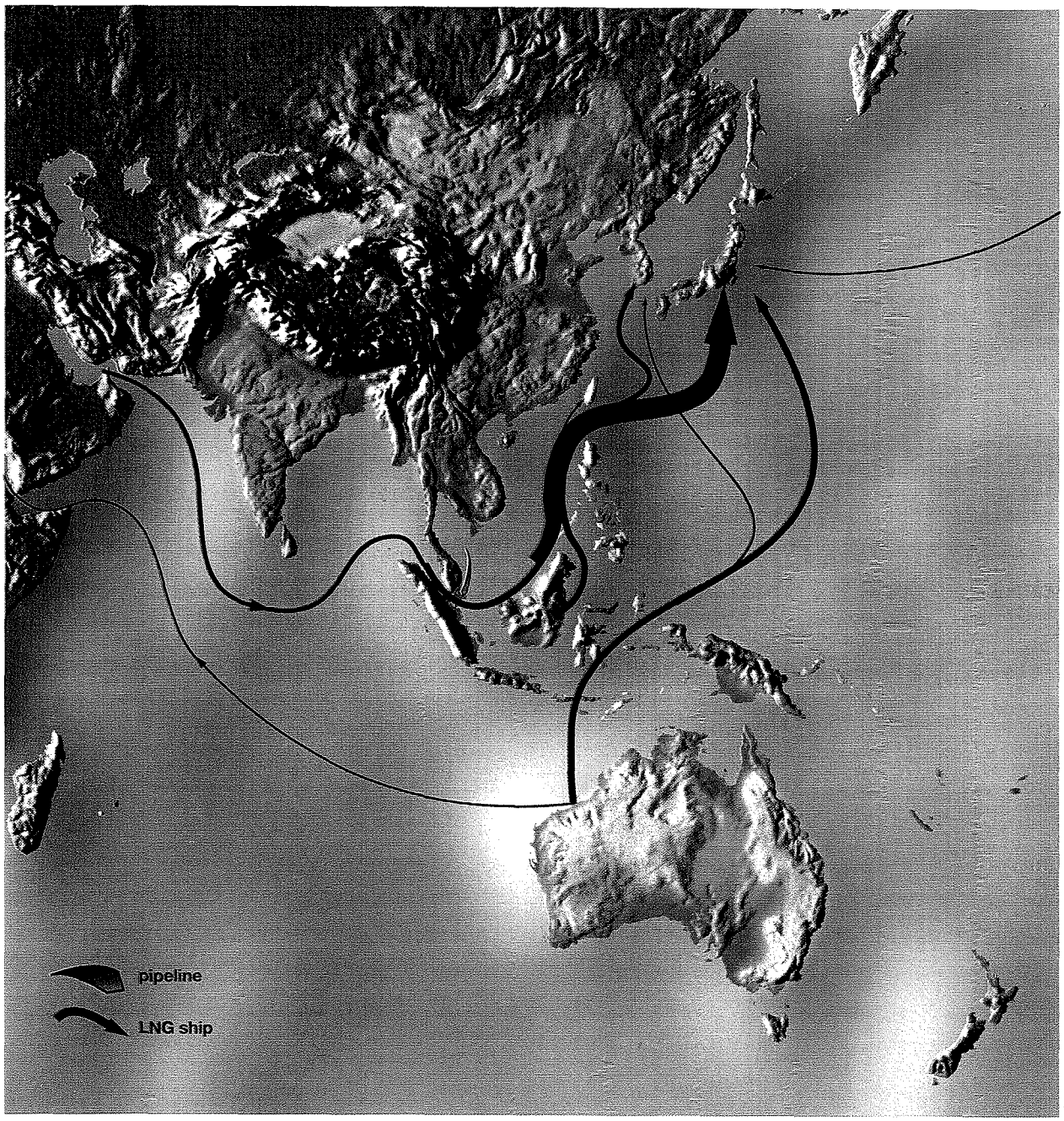
EXPORTERS	TRAINS
A Blang Lancang, Indonesia	6
B Bintulu, Malaysia	3
C Lumut, Brunei	5
D Bontang, Indonesia	6
E Withnell Bay, Australia	3

Imports by pipeline 1993

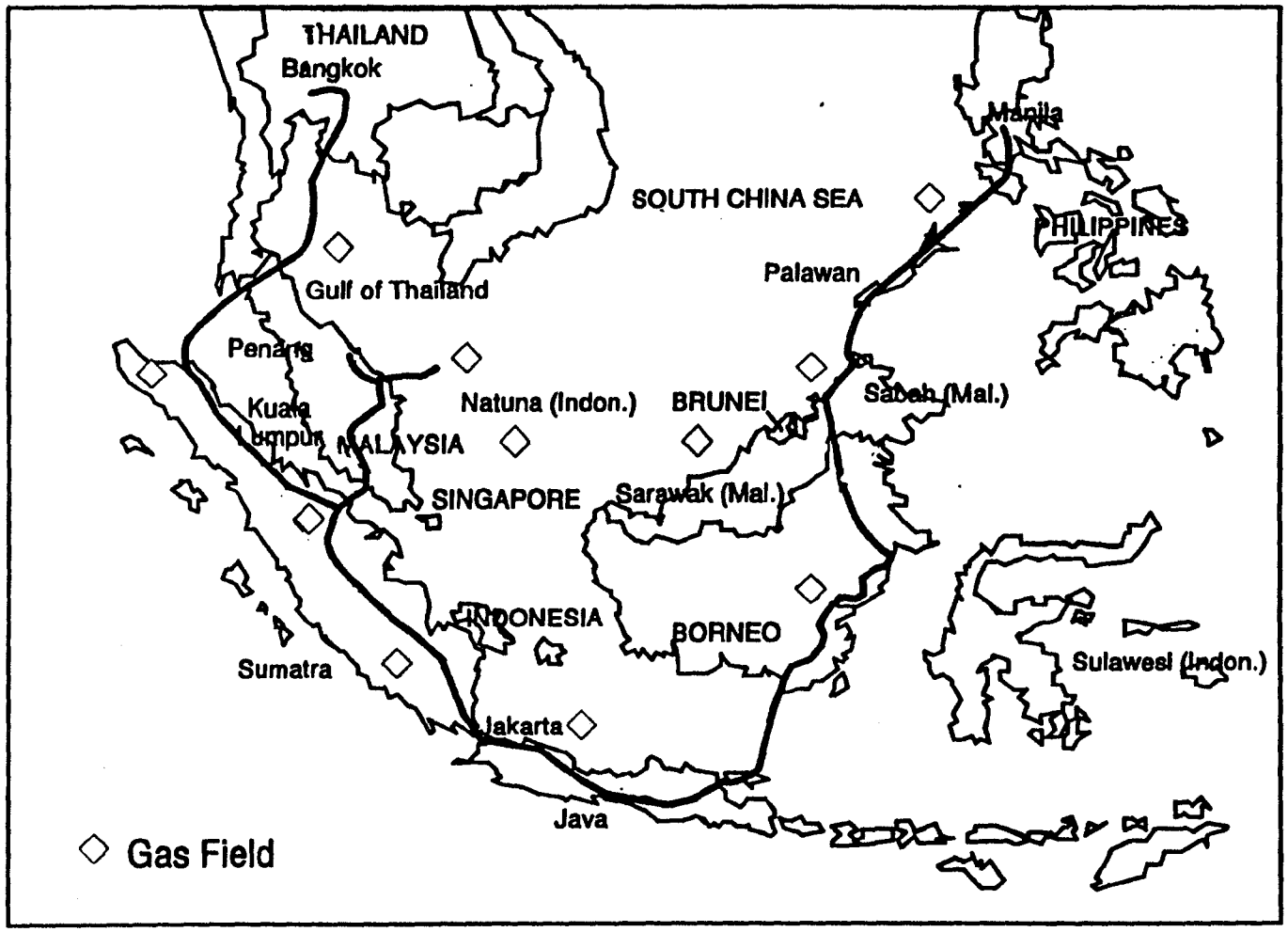
(bcm)

EXPORTER													IMPORTER	
USA	Canada	Bolivia	Mexico	Denmark	Germany	N'lands	Norway	UK	FSU	Iran	Algeria	Malaysia		Total Imports
												1.50	Singapore	1.50
												1.50		

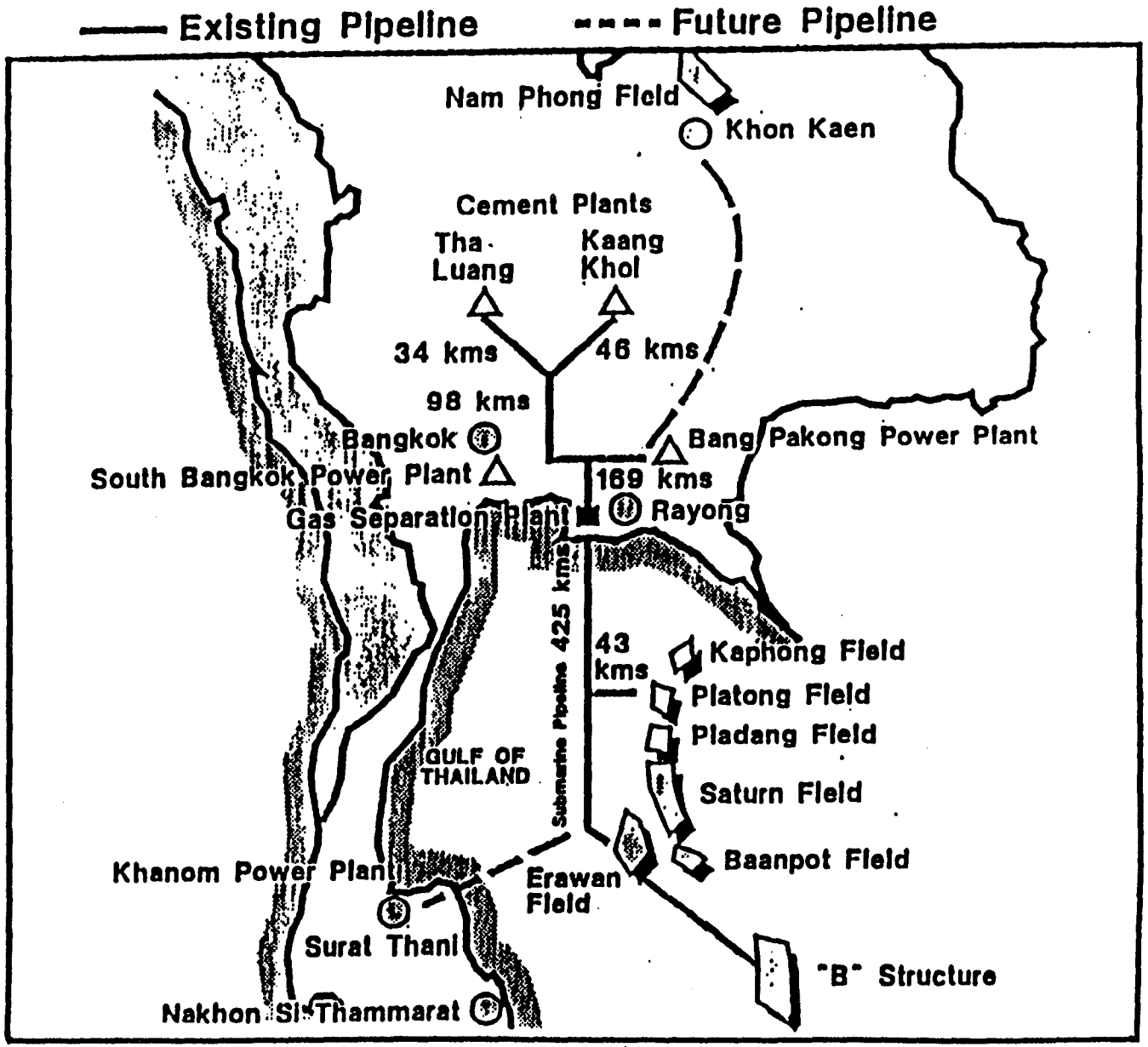
Inter country/regional trade flows



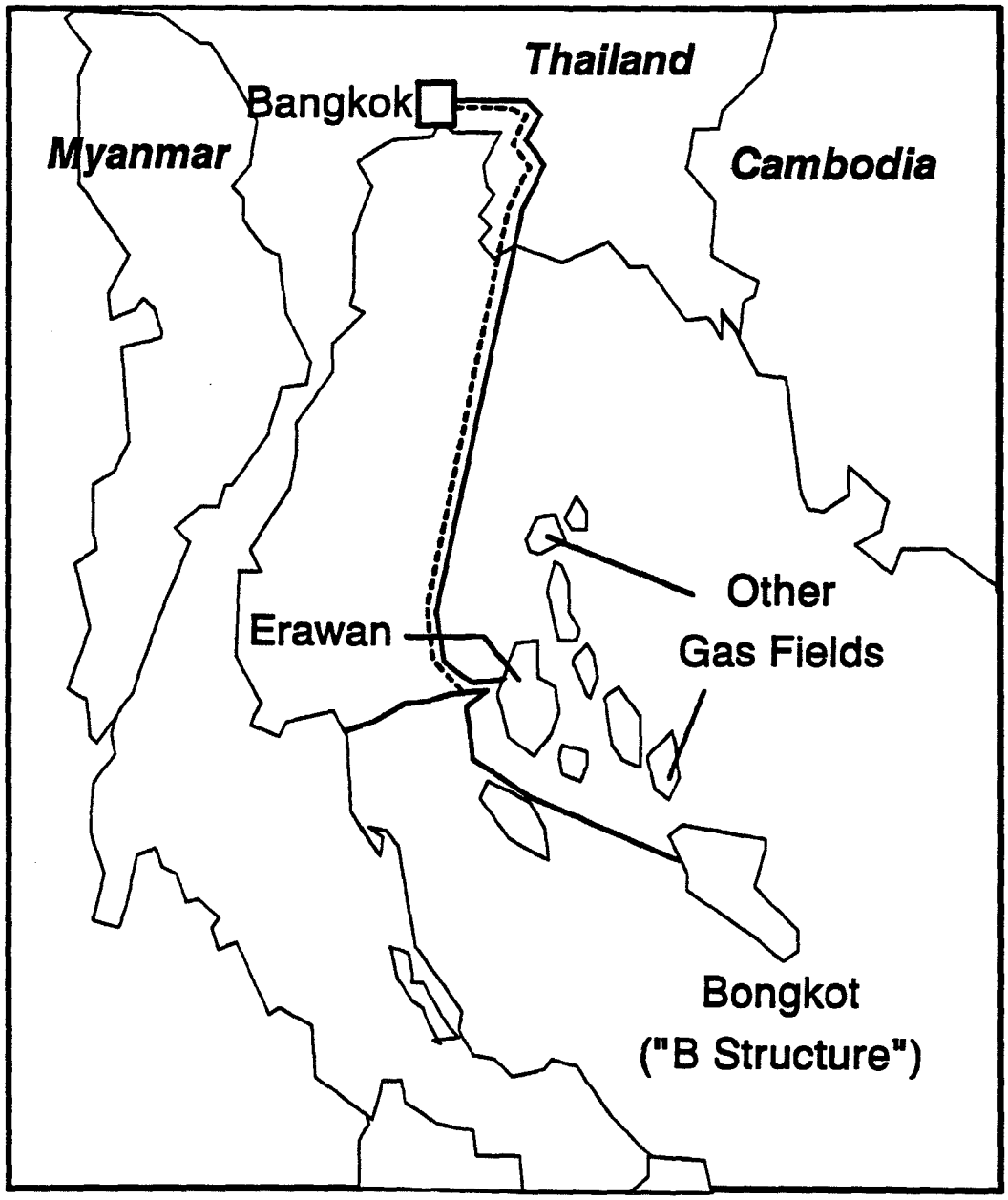
TRANS ASEAN PIPELINE (5,000 miles total)

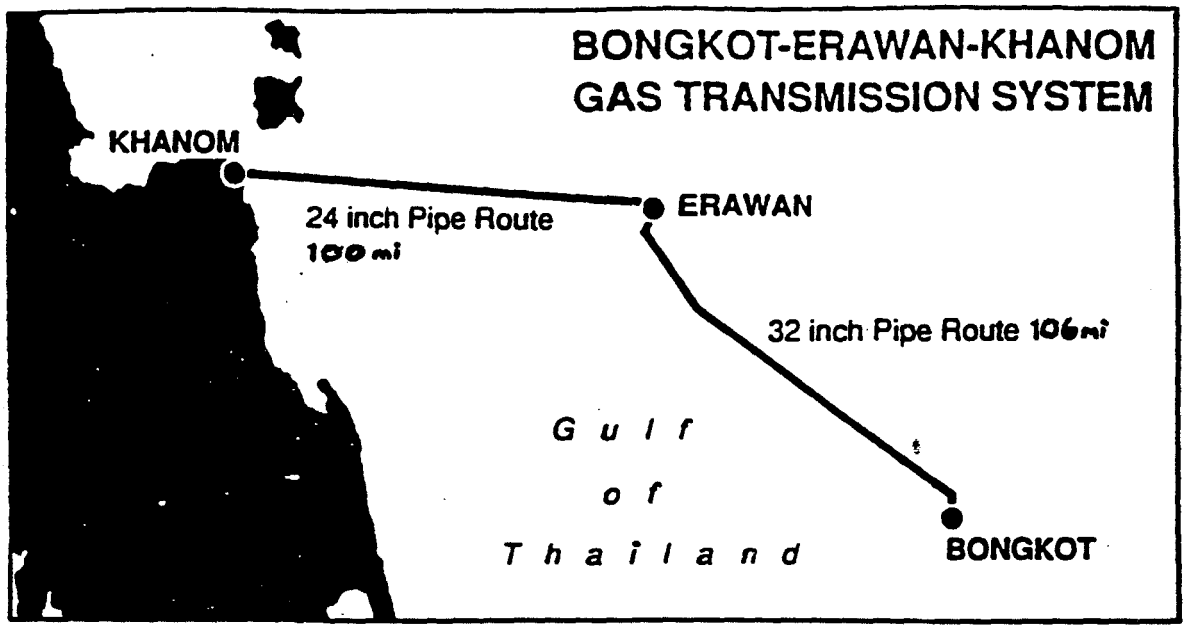


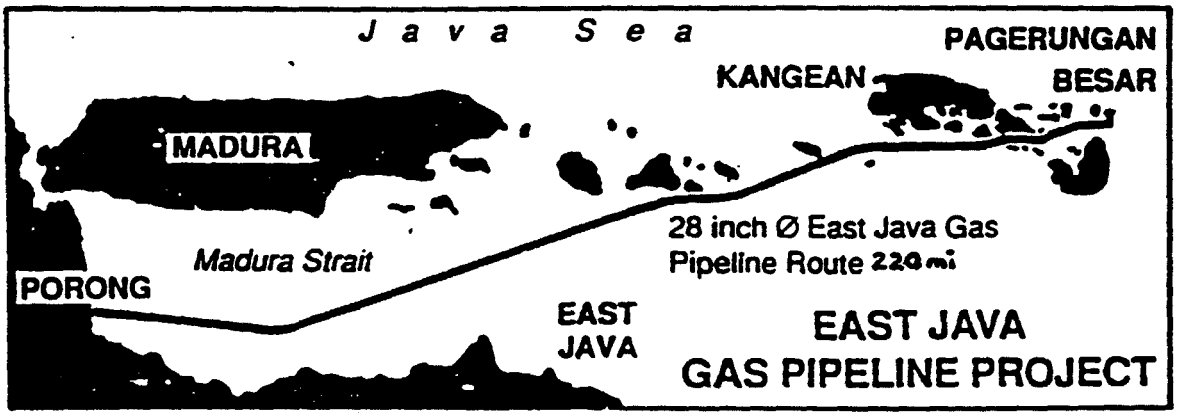
PTT's Natural Gas Transmission System

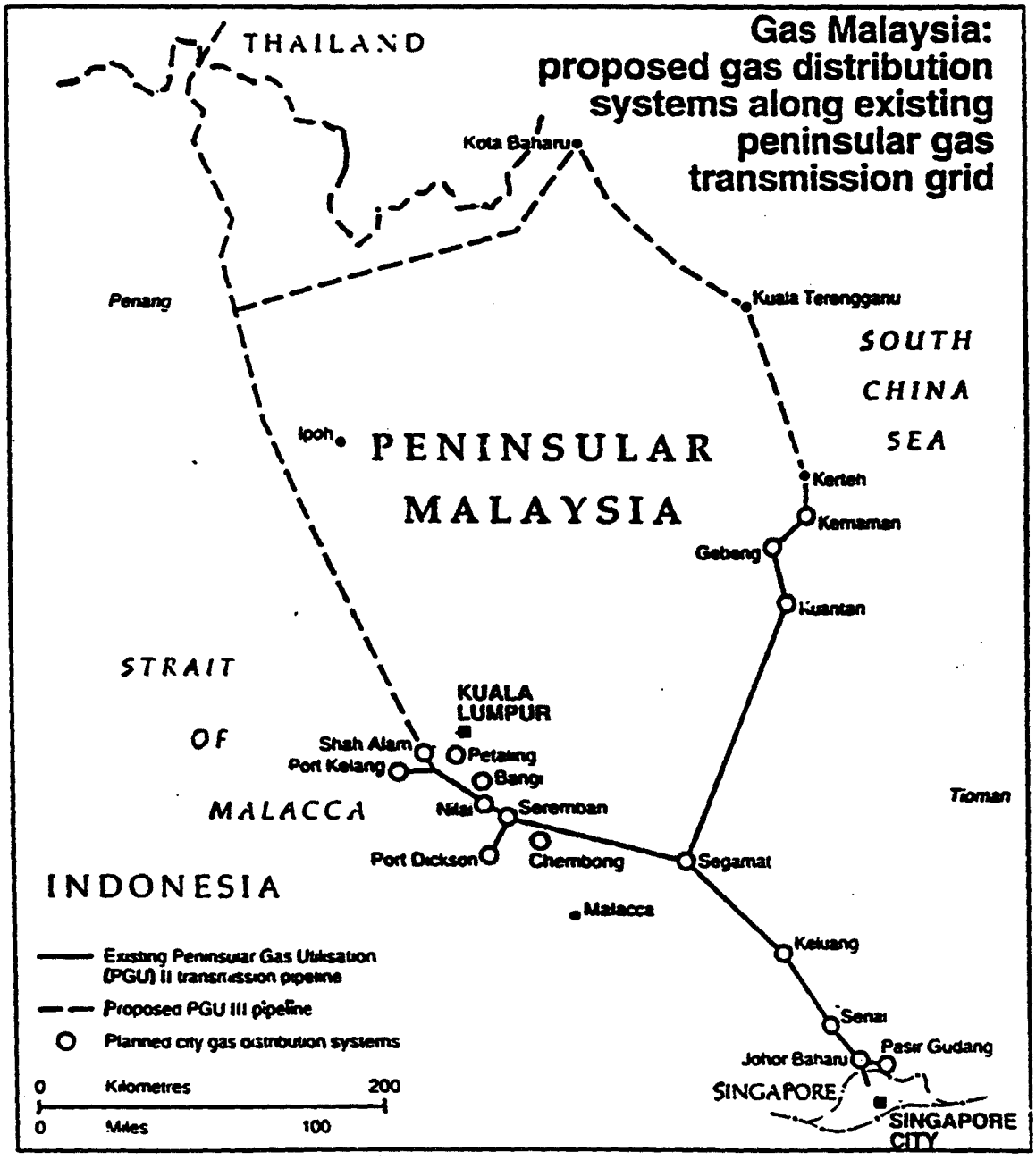


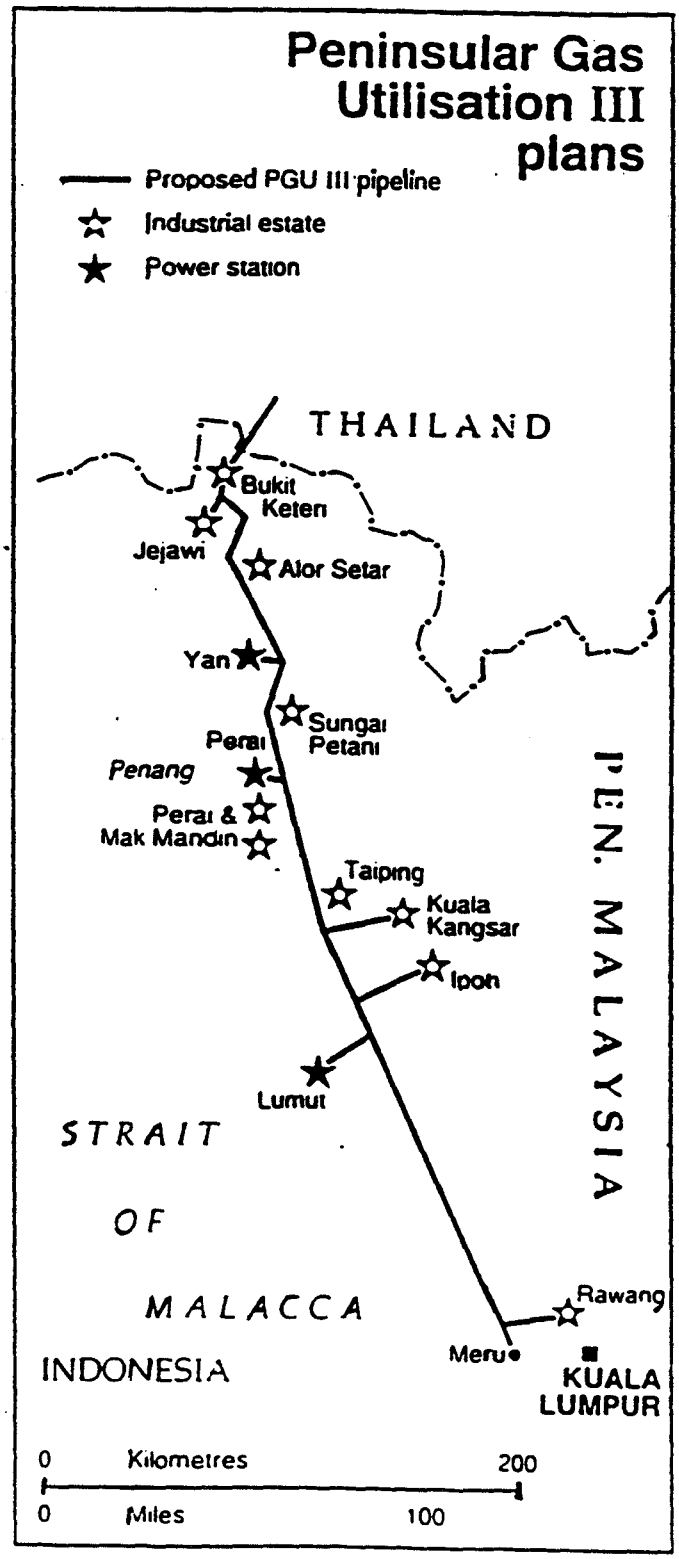
ERAWAN-BANGKOK PIPELINE



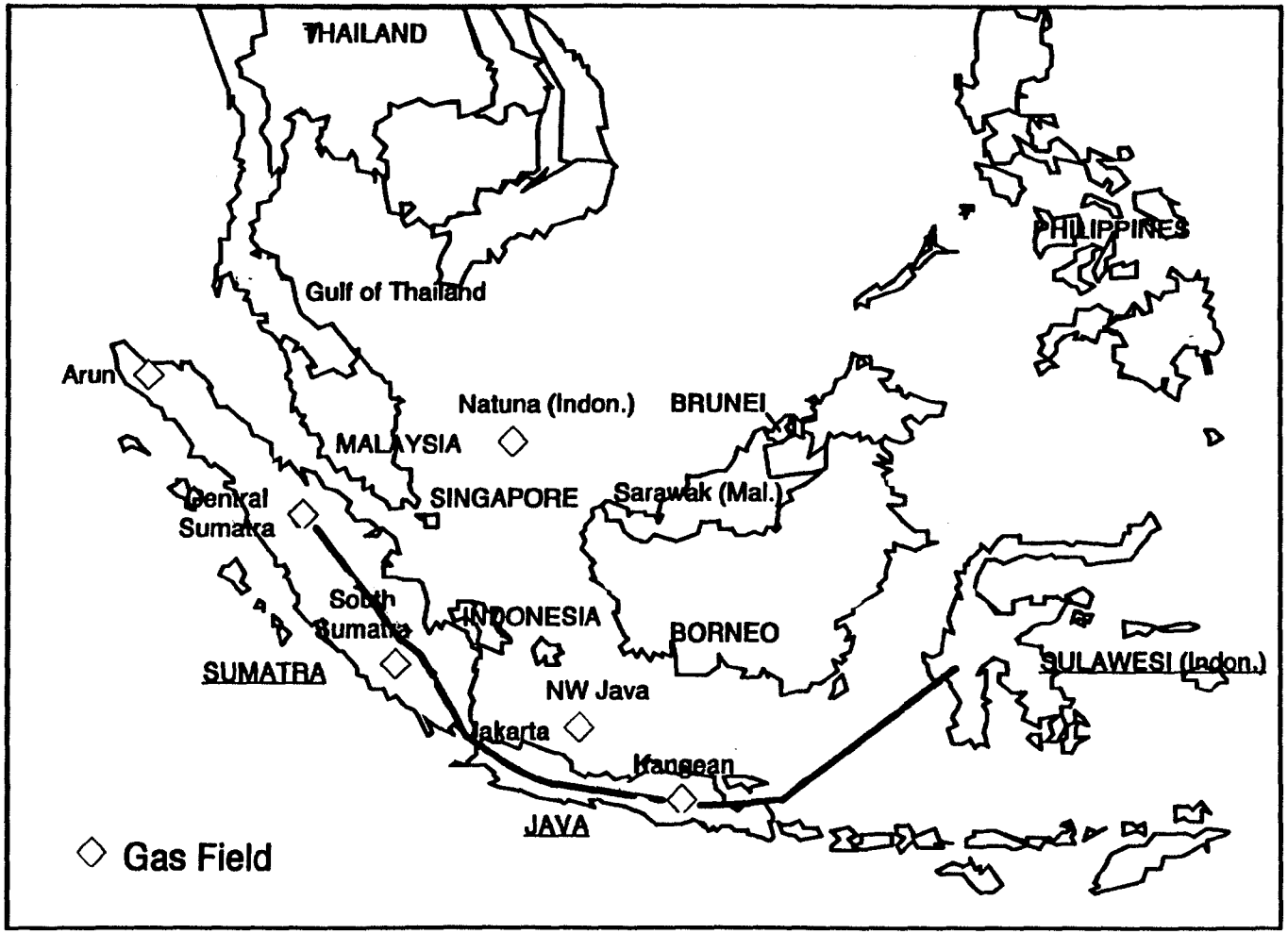

BONGKOT-ERAWAN-KHANOM
GAS TRANSMISSION SYSTEM
KHANOM
ERAWAN
24 inch Pipe Route
100 mi
32 inch Pipe Route 106mi
Gulf
of
Thailand
BONGKOT


Java Sea
PAGERUNGAN
BESAR
KANGEAN
MADURA
28 inch Ø East Java Gas
Pipeline Route 220mi
Madura Strait
PORONG
EAST
JAVA
EAST JAVA
GAS PIPELINE PROJECT

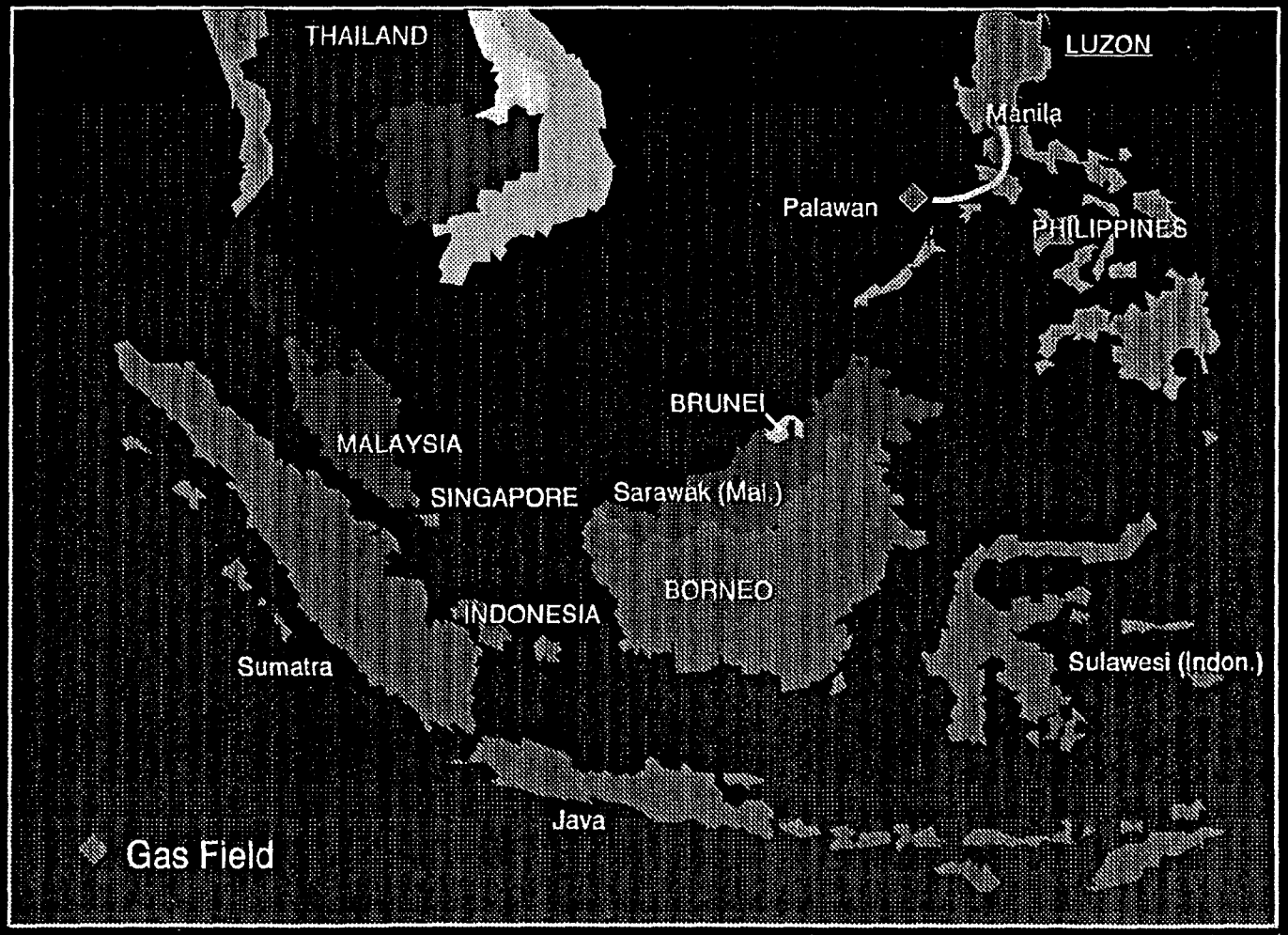

Gas Malaysia:
proposed gas distribution systems along existing peninsular gas transmission grid
THAILAND
Kota Baharu
Penang
Kuala Terengganu
SOUTH CHINA SEA
Ipoh
PENINSULAR MALAYSIA
Kerteh
Kemaman
Gebeng
Kuantan
STRAIT OF MALACCA
KUALA LUMPUR
Shah Alam
Petaling
Port Kelang
Bangi
Nilai
Seremban
Tioman
Port Dickson
Chembong
Segamat
INDONESIA
Malacca
Keluang
Existing Peninsular Gas Utilisation (PGU) II transmission pipeline
Proposed PGU III pipeline
Planned city gas distribution systems
Senai
Johor Baharu
Pasir Gudang
SINGAPORE
SINGAPORE CITY
0 Kilometres 200
0 Miles 100


Peninsular Gas Utilisation III plans
Proposed PGU III pipeline
Industrial estate
Power station
THAILAND
Bukit Keteri
Jejawi
Alor Setar
Yan
Sungai Petani
Perai
Penang
Perai & Mak Mandin
Taiping
Kuala Kangsar
Ipoh
Lumut
STRAIT OF MALACCA
INDONESIA
PEN. MALAYSIA
Rawang
Meru
KUALA LUMPUR
0 Kilometres 200
0 Miles 100

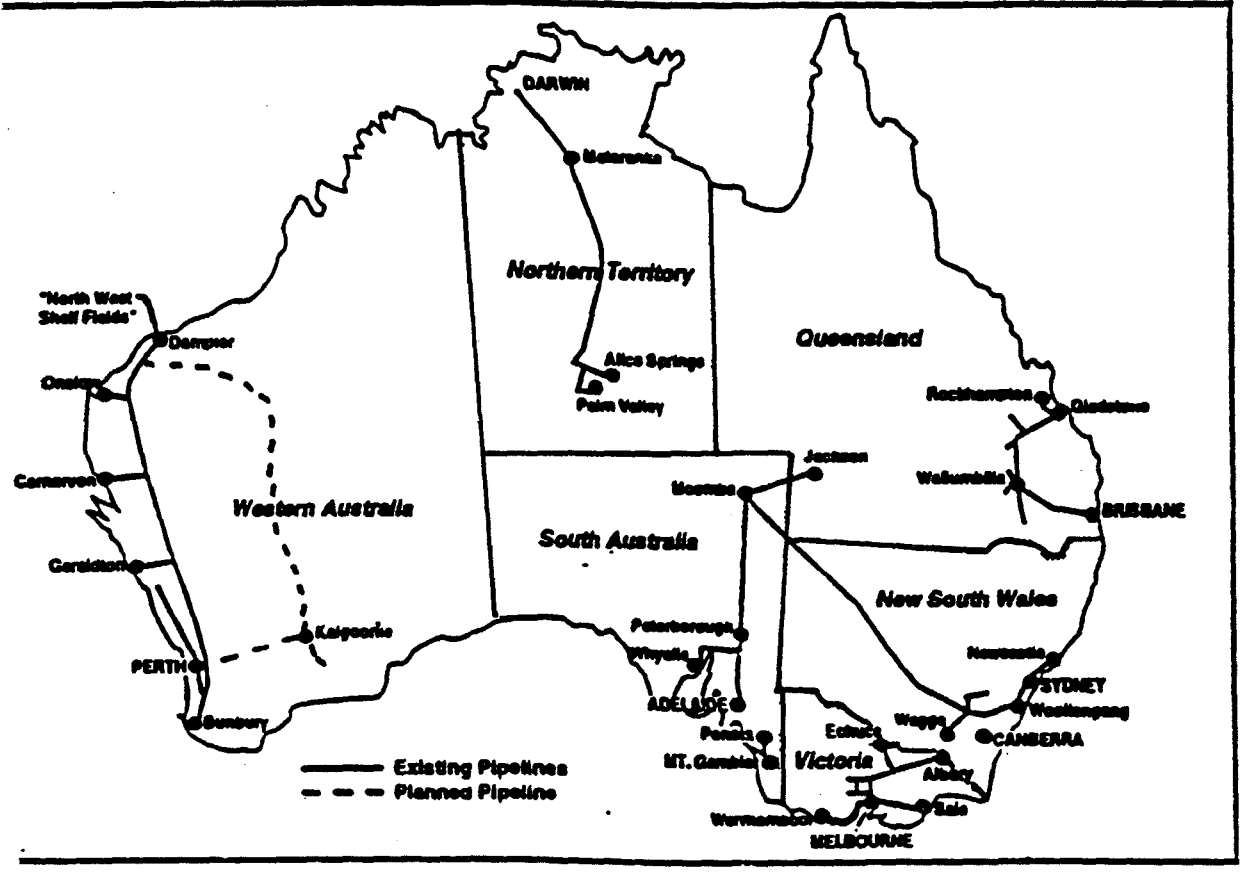
INDONESIAN PIPELINE PLANS (1,400 miles total)



PHILIPPINES PIPELINE PLAN



Australian Gas Transmission Systems



Background

Far eastern countries continue to hold a strong position for current and future projects with an aggressive effort to move natural gas to consuming markets.

Long distance gas transmission, gathering and lateral networks, along with substantial projects to supply former Soviet Union gas to Korea and Japan, hold the future for pipe line construction.

A detailed examination of possible gas supply/demand balances indicate, in the light of the above, a regional surplus supply position by 2010.

Trans Asia Natural Gas Pipeline

New Silk Road. Chinese authorities have confirmed their examination of a plan to pipe Turkmenistan gas to China's Tarim Basin, there to connect with a future 1,500 mile pipeline south-eastward to China's coast. The Turkmenistan/Tarim project is consistent with China's plans revealed in 1993, to develop a "New Silk Road" to connect central Asia's rich gas-prone fields with end users in north east Asia. This proposal came out of a meeting between the Turkmengaz Association, Mitsubishi Corp., and China National Petroleum Corp.

The intention would be for gas from local fields in the Tarim and Turphan - Hami basins, yet to be developed, to be mixed with Turkmenistan gas after its passage through Uzbekistan and Kazakhstan. From there the gas would be transported to Luoyang in central China where it would be divided among Beijing, Tianjian, Shanghai and Fujian provinces. From these locations gas would be delivered via subsea pipe lines to South Korea, Japan and Taiwan respectively.

The "New Silk Road" project cost is estimated by Mitsubishi at $12 billion with a five year completion time (some commentators put the cost as high as $20 billion). The $12 billion estimate provides a 3,700 mile 56in pipeline of 1,059 bcf/year capacity from Turkmenistan through Uzbekistan and Kazakhstan to China, and, a 506 bcf/year liquefaction plant on the Yellow Sea. These facilities would meet domestic use in China and export requirement to Japan.

Turkmenistan gas delivery to Japan for which two options are under study. First, a network of lines totalling 3,800 miles onshore and 490 miles offshore. The subsea line would connect Shanghai and Nagasaki via Cheju Island. Second, the pipeline and liquefaction plant described above.

The totality of these proposals is subject to a project study due for completion early in 1995. Study outcome could lead to a five year development program which would dominate the northeast Asia gas market into the next century, including a possible "free ride" for South Korea. Positive progress of the project would appear to signal significant delay for the development of east Siberian gas reserves.

China's state-run natural gas corporation is capable of installing in the order of 2,000 miles a year of pipelines and thus would be able to complete the proposed trunk line in about two years. There is a possibility that the cost may be partly covered by Japan's 5 year program for official development assistance (ODA).

Japan

(1) Numerous proposals continue to surface regarding ways to supply Japan with natural gas. One is for a pan-Asian gas network involving a grid throughout Japan that at some time would include a scheme to transport gas from former Soviet Union through Korea and Southeast Asia. It is recognised that anything operational before 2005 is unlikely.

Studies have focused on a 2,050 mile line to move gas from Sakhalin or eastern Siberia's Yakut area and distribute it through Japan. Best estimates show five year construction at a cost of $23.6 billion. Plans hinge on development of Sakhalin Islands offshore gas reserves.

Under another plan, gas from the Yakut field would be delivered to Korea and Japan through a 2,700 mile system by way of Yakutsk, Khabarovsk, Vladivostok, both Koreas to Kyushu in western Japan.

(2) The most recent development has been the early-1994 report that the Ministry of International Trade and Industry (MITI) is carrying out a wide ranging review of the country's natural gas industry in preparation for a national policy on gas utilisation development to take Japan through to the next century. Results of this review are awaited with keen interest by Japan's city gas companies and major industrial users of natural gas including several electric power companies. The review is the result of the government's desire to develop gas as a clean fuel. It follows more than five years of private sector studies into the construction of a national gas grid. In mid 1991 MITI established a Committee for Fundamental Issues on Natural Gas which consulted gas company representatives, consumers and other interest groups. MITI is now studying how to put the committee's recommendations into effect.

The programme will have important ramifications for Japan's entire energy sector as MITI wants to encourage the large scale development of natural gas utilisation by elevating gas to the status of a fundamental energy resource.

This policy will require major changes in the structure and organisation of gas supplies, storage and transmission. The development of natural gas transmission networks is high on the agenda.

Japan has constructed 10 LNG coastal import terminal facilities around the country which supply local customers by pipeline and by truck distribution. However, planning restrictions on the location of LNG terminals may prevent many new terminals being built. Better use will need to be made of existing LNG terminals. New gas transmission pipeline networks will lead to the creation of gas transmission companies, to work alongside the existing LNG terminal operators and city gas distribution companies. City gas companies are expected to play a major role in establishing and

running the gas transmission companies. MITI is considering how to generate private investment to fund the gas transmission companies.

(3) A high pressure transmission grid linking Tokyo, Nagoya and Osaka is envisaged. Japan's largest three cities are home to the country's largest electricity companies and city gas utilities.

A 2,050 mile pipeline network between Hokkaido in the north and Kyushu in the south would cost about $30 billion. The grid could not be built before some years into the next century.

However, the first segment of such a planned expansion is scheduled for completion in 1996. This is the target date for completing a 155 mile natural gas pipeline from Nugata on the Sea of Japan coast across the country to Sendai on the Pacific coast. The 20in line will pick up the gas at an LNG regasification facility at Nugata. Main customer for the gas will be the gas-fired power stations operated by Tohoku Electric. Planning schedules mark construction of 62 miles in 1995 and 31 miles in 1996. Routing crosses the central mountain ranges that form the spine of Japan. Kawasaki Steel is supplying 36% of the pipe and has responsibility for materials and construction. The remainder of the pipe will be supplied by Sumitomo Metals Industries, NKK Corp and Nippon Steel.

China

(1) China National Petroleum Corp's affiliate in Sichuan has begun operating a 160 mile gas line that ties the Moxi field to a nearby distribution system. Flow capacity is about 45 mcf/day.

(2) Sofregaz, a subsidiary of Gaz de France, has signed a contract with Ghengdu Gas Co., China, for the supply of gas storage and distribution equipment and a SCADA system for the city's gas network. Sofregaz recently completed management of a SCADA installation for the city of Beijing's manufactured gas network..

(3) Sofregaz has signed, a $26 million contract with China National Technical Import and Export Corporation and Xian National Gas Company.

Under the terms of the contract, which forms part of a major trade agreement between France and China, Sofregaz is to provide engineering and procurement services for the Xian natural gas distribution system.

The city of Xian, situated south-west of Beijing in the Shaanxi province, has a population of more than 2.5 million people. To date, gas has been supplied to some 75,000 customers through the city's manufactured gas distribution network. With the new, natural gas distribution network, the number of customers serviced could be increased ten-fold.

(4) It was reported in April in 1994 that China had signed an agreement with a US-led consortium for construction of the world's longest coal slurry pipeline. The $888 million project would be completed by 1997.

The agreement between Pittsburgh-based Custom Coals and China's Ministry of Coal Industry provides for 51% foreign ownership and is the first infrastructure project of its kind in China to have western financial and management control. The 500 mile pipeline from Shaanxi province in China's north-west to the coastal province of Shandong could open the way for many such projects to service the world's biggest coal producer.

The Chinese transport system is greatly over-stretched, and with coal shipment representing 40 per cent of the country's rail traffic, a coal slurry pipeline will provide a much needed alternative and port facilities.

The Yu-Wei project will include the construction and operation of a coal cleaning plant, pipeline and port facilities. Custom Coals will also supply coal cleaning technology, which will greatly reduce China's coal burning costs.

(5) Pipeline laying started at the end of 1993 and was completed by end 1994 for the 438 mile 28in Yacheng 13-1 to Hong Kong subsea gas trunk pipeline in the South China Sea.

According to pipeline authorities, it is the longest offshore pipeline ever constructed within a single lay season and with one lay vessel in a continuous program.

The Yacheng 13-1 gasfield is situated 56 miles southwest of Syna, on the southern coast of Hainan Island. Arco China Inc. is the operator of the project on behalf of partners China National Offshore Oil Corp (CNOOC) and Santa Fe International Corp (SFIC).

The pipeline installation contract was awarded in three sections - the main trunkline; the Pearl River mouth/Hong Kong approach; and a separate line from the Yacheng 13-1 process platform to Syna.

Installation of the main line was handled by a joint venture between Saipem and European Marine Contractors (SEJV). The latter company is equally owned by Saipem and Brown and Root.

The Yacheng-Hong Kong line is second only to the North Sea Zeepipe 1 system in offshore pipeline length, also installed by EMC's semi-submersible pipelay barges. Pipeline laying using the Semac 1 semi-submersible pipelay barge was completed in mid 1994

The main customer for Yacheng gas is Castle Peak Power Co Ltd of Hong Kong (Capco), a company held 40 per cent by China Light & Power Co Ltd of Hong Kong and 60 per cent by Exxon Energy. Under the gas sales contract, the consortium will deliver first gas to Capco by July 1996 and reach the full contract amount of up to 670 mscf/day by 1999.

A total of four 600-MW generating units will be installed by Capco at a new power station under construction at Black Point, near Tuen Mun in the northern New

Territories of Hong Kong. One 600 MW unit will be brought on stream each year between 1996 and 1999. Each will be capable of being fired by either natural gas or industrial diesel.

Under a separate sales contract, some 50 mscf/day gas will be delivered to Syna on Hainan Island, where a 1,765 tons per day urea plant will be built.

Performance on the Arco China Hong Kong Gas Trunk Line to Yacheng 13-1 led to SEJV being awarded the additional work for the project. The pipeline work is part of a $1.2 billion gas project for onshore and offshore facilities. The new work included the pipeline from Arco China's offshore facilities to Hainan Island and a continuation of a 28 inch diameter line across the Peal River Estuary, laid by Saipem's Castro V pipelay vessel.

The work commenced at the starting point of the main trunkline - some 37 miles southwest of Hong Kong - and continued to the Black Point in the Hong Kong New Territories.

The first project, using EMc's Semac 1 semi-submersible lay barge, called for laying a 14 inch diameter 60 mile pipeline from the platform to the Hainan Island. The work included shore approach, platform tie-in, an intermediate tie-in for compression facilities and flooding, gauging and hydrotesting.

The second award involved laying the final 43 miles of the 28 inch diameter trunkline. The main part of the trunk line underway with SEJV was completed by end 1994.

(6) For China's National Petroleum Corp. the PLE Co of Germany is close to completion of the basic design of a project for laying gas pipelines from the Shaanxi-Gansu-Ningxia gas field to Beijing. The 556 miles of pipelines are to start from Jingbian county in Shaanxi Province; pass through Luliang Shan, Heng San and Taihan Shan; span five long rivers, including the Yellow River; and end up at Yamenkou in Beijing's Shijingshan district. Detailed design will be handled by China's SPA Design Institute in conjunction with PLE. Construction is planned in the first half of 1995 and gas will be supplied to Beijing by 1998. Upon the completion of the first phase work, about 36 billion cu ft. of gas will be supplied to Beijing.

(7) China National Oil has the following projects under consideration.

(a) 196 mile gas line from Jingbian to Yinchuan
(b) 372 mile of gas line from Jinbian to Xtan

These two lines await Central Government approval although the SPA Design Institute is working on basic and detailed designs.

(c) 86 miles of gas lines on Hainan Island
(d) gas pipeline running along the coastal areas of Guangdong, Fujian and Hainan provinces
(e) The 190 mile 8-24in gas line under construction between Yungan and Tunghsiao is scheduled for completion in 1995.

(8) China continues to look at distribution grid and related facilities that would measure up to 4,400 mile. The grid, covering several provinces, would move both natural gas and regasified LNG.

(9) The Pipeline Bureau of the China National Petroleum Corp, (CNPC) plans to go forward with a refined products pipeline known as the Great Southwest Pipeline.

Plans call for the line to extend from Beihai in Guangxi province through Nanning and Liuzhou to Guiyang in Guzhou province. At Guiyand, the line will take different directions, Chongquing and Kunming. The line will measure 1,454 miles. Pending construction start, the line is scheduled to be in service late 1998.

(10) Metrotect Industries plc, a UK world leader in the manufacture and supply of pipeline protection products, has signed a joint venture with the Pipeline Scientific Research Institute (PLSR) of Langfang, in the Peoples Republic of China.

The agreement, to manufacture plasticised coal tar enamel for the protection of steel pipelines from corrosion, is the first of its kind to be signed in China.

(11) Hong Kong - Hong Kong and China Gas Co plans to lay a gasline to Lanatau Island during 1995 to supply town gas to the outlying islands.

The company is looking at gas production and distribution in China. It is studying feasibility of a joint venture to supply gas to Panyu in Guangdong province.

Vietnam

(1) Work was completed in late 1994 for Vietgas on laying a 77 mile pipeline to transport associated gas from Vietnam's White Tiger (Bach Ho) offshore oil field. The project was carried out by Hyundai Heavy Industries of South Korea with John Brown providing engineering services.

The pipeline is Vietnam's first offshore gas pipeline. It includes a 66 mile 16 inch offshore section and a further 10 mile onshore and will link White Tiger to Ba Ria power station near the coastal oil industry centre of Vung Tau. Gas is currently flared at the field in the absence of any means of transport. The estimated cost of the project is $100 million. A $50 million extension may eventually be built over 53 miles inland to the Thu Duc power plant.

(2) A consortium of foreign firms is to look into ways of opening up the Vietnamese gas market.

Petrovietnam, the Vietnam oil and gas corporation, has been given full approval by the Vietnamese government to award exclusive rights to a consortium comprising British Gas, Mitsui, TransCanada pipelines Limited and Petrovietnam, to prepare a feasibility study (see (3) below).

(3) The proposed Vietnam Gas Utilisation Project, the first major new infrastructure project of its kind, will use associated gas being flared offshore at the Bach Ho oil field. The gas will be used as an energy source for power generation and the development of new industries within the country.

The feasibility study - a precursor to the planned $400 million project - if accepted would see British Gas, Mitsui, TransCanada and Petrovietnam form a joint venture company.

The program of work requires the partnership to collect the gas from the Bach Ho field, pipe it via a 16" offshore pipeline, and build a compression and riser platform at White Tiger plus an LPG plant onshore at Vung Tau. An onshore pipeline would also be built to transport the gas to users, including a line from Vung Tau to Ho Chi Minh City. The construction of the pipeline, by Hyundai of Korea, reported under (1) above would be purchased by the group. Estimated completion 1996.

(4) British Gas and Arco have a production sharing contract with Petrovietnam for Block 4.1 150 miles south-east of Vung Tau on Vietnam's southern coast in the northern part of the Con Son basin. Drilling is currently underway.

Meanwhile, rumours abound of a huge gas field discovery under the sea off Vietnam by BP who are reputed to be talking to British Gas about infrastructure development and a possible gas fired power station.

(5) Petrovietnam scheduled for 1994 work progression the following two gas pipeline construction projects:

- 434 mile line from Dai Hung to Erewan
- 109 mile line from Bachtto to Vuns Tu.

Korea

(1) There is an existing natural gas pipeline 140 miles in length with a further 95 miles under construction. It will then be extended a further 93 miles to Dejon.

(2) Korea Gas Corp., (KCG) is moving ahead with a 820 mile system to carry natural gas to commercial, industrial and domestic users in South Korea's central and west coast regions. Installation is underway in the country's central region.

(3) Replacement and relocation of existing lines in the Honam and Youngnam is nearing completion. The work was required to make room for ongoing highway construction.

(4) KGC is expanding existing LNG receiving terminals and related facilities with completion scheduled for 2006. Project cost is in the $2 billion range.

(5) Construction is moving closer to reality on a KGC planned 186 mile 20in gas line from Pyongtaek to Kwangju in the southwest.

(6) The government has approved an agreement between South Korea and Russia for a feasibility study for a gas line from Yakutsia, east Siberia, to South Korea crossing North East China and North Korea. North Korea would take some of the gas. A South Korean consortium comprising Pedco, Daewoo, Yukong Oil, Samsung and Lucky Goldstart, has already been formed to take part in the project.

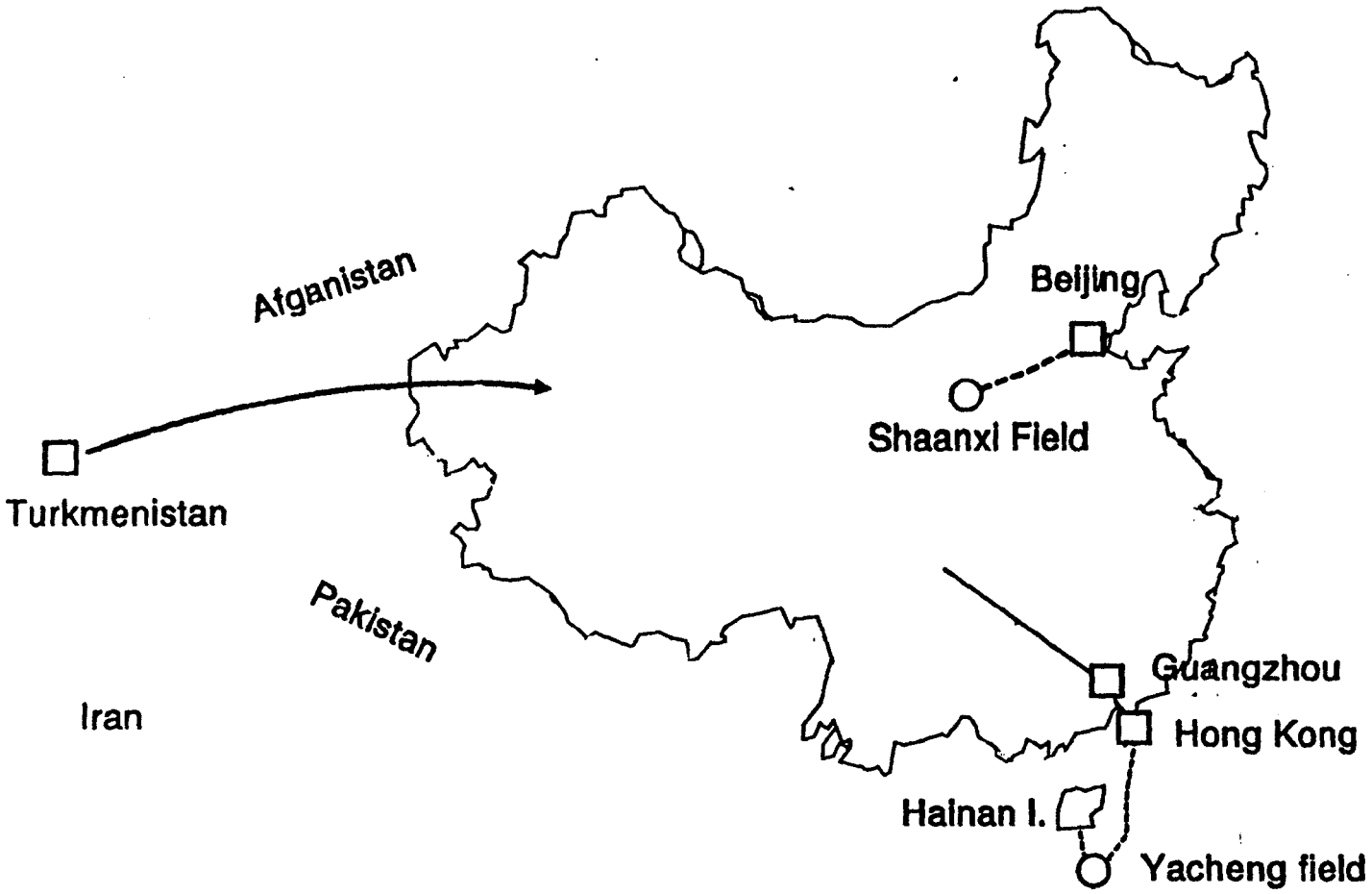
Taiwan

(1) Existing natural gas pipeline is 217 miles.

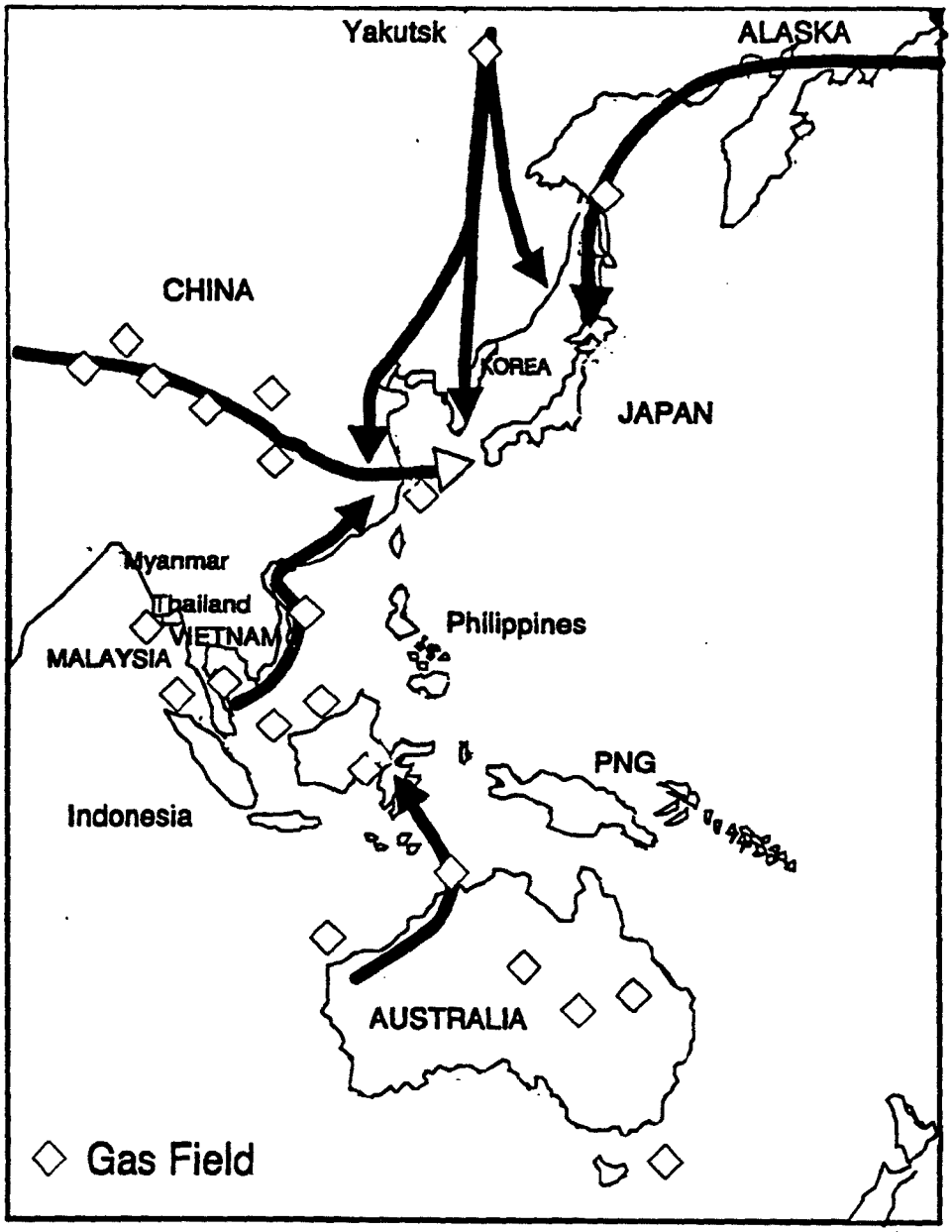
(2) Expansion of the Yungan liquefied natural gas receiving terminal is planned. The $2.6 billion project includes a 143 mile gas line running offshore from the terminal to Taiwan. Construction is set to start in 1995.

(3) Chinese Petroleum Co. is to build a 179 mile 24in gas pipeline between Tung-Shiao and Kao Hsiung.

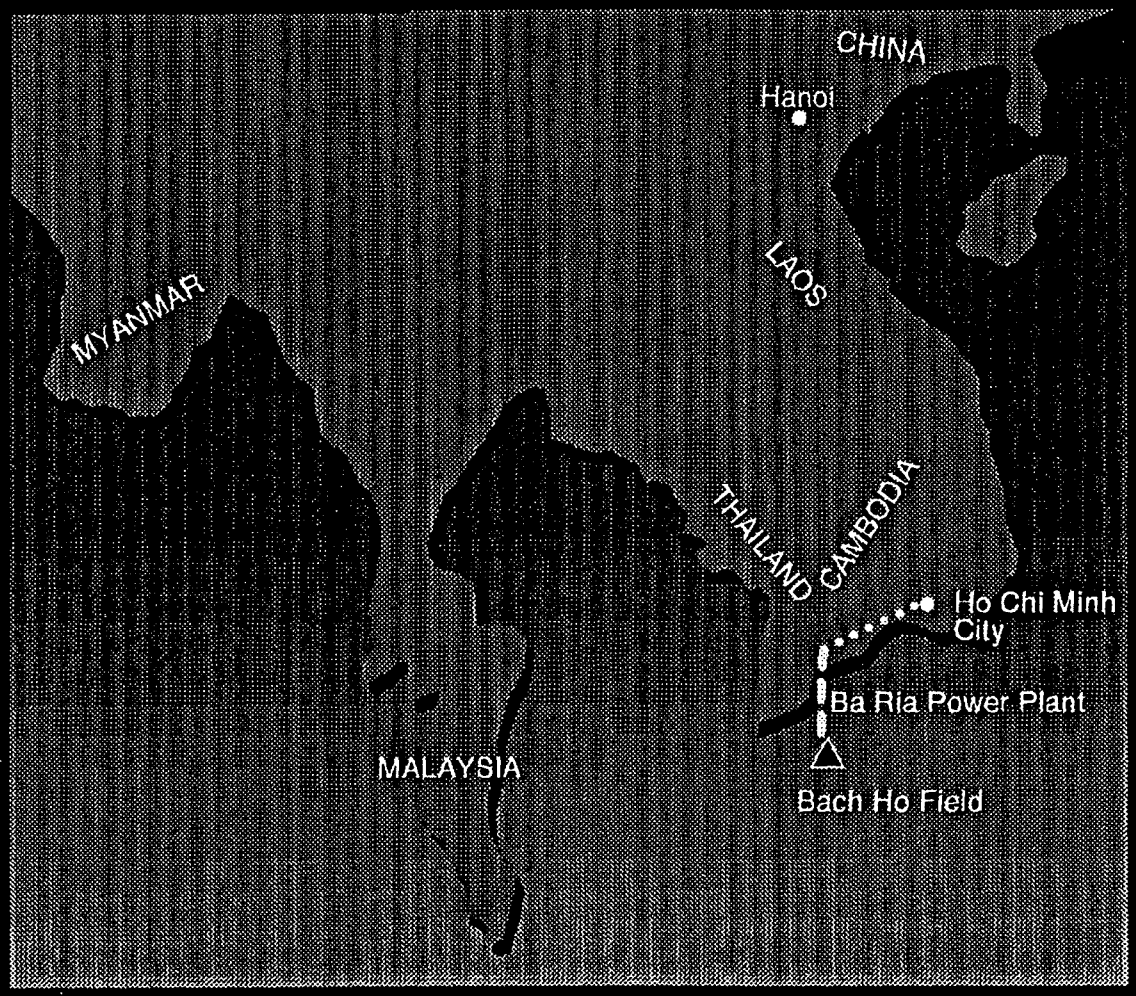
CHINA GAS TRANSMISSION



TRANS ASIA NATURAL GAS PIPELINE
26,000 MILES TOTAL



VIETNAM PIPELINES



(4) In conjunction with (3) above, India's Oil and Natural Gas Commission (ONGC) has granted a detailed design, laying, installation and burial contract to NPCC Singapore for the ICP Heera trunkline project off Bombay. The 88 mile, 30 inch diameter concrete-coated line will move gas from the Bombay High region to shore. The total project cost is $500 million.

(5) Attention is being given to GAIL's proposal for a national gas grid linking north, south, east and west regions of the country. Such a system would require more than 11,400 miles of various diameter pipes.

A significant step towards this objective is the call by the modern states of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu for a feasibility study of a pipeline to meet their needs.

Nevertheless slow progress on development of the long-mooted southern gas grid concept has been irking Tamil Nadu state. Gas supply source is the bone of contention between the power and natural gas ministry of the central government in new Delhi and the Tamil Nadu government.

The ministry is linking the grid project with the proposed pipelines planned to take gas from Oman and Iran to India. Tamil Nadu says the gas can be sourced from the western offshore and the grid plan can be implemented without waiting for firming up of the Oman-India line. But the petroleum ministry argues there is already too much demand pressure on western offshore gas and southern states cannot be accommodated there.

Tamil Nadu also reckons gas from Bombay High fields will be much more cost effective than gas from abroad. Nevertheless, given the slow grid progress so far it is now exploring the option of importing LNG from Malaysia. Its eagerness to tie up a fuel source is explained by some $3.33 billion investment which the state is expecting in the next two or three years in power, refinery, port development and desalination projects.

(6) At the end of 1994 it was announced that a new joint venture company comprising GAIL and British Gas is to handle the transport of a piped natural gas supply to the city of Bombay initially using gas from Bombay High Field. Although first customers will be connected in late-1995 a period of 12 years will be needed to connect 600,000 customers to a new polyethylene distribution pipeline network. British Gas and GAIL will each have a 35% share in the new company (Mahanger Gas). The remaining 30% share will be held by the government of Maharashtra State directly and by the general public through a public share offer.

(7) Enron Corp., Bechtel Enterprises and GE Capital are to build a $2.5 billion power plant in India. The group will work with the Maharashtra State Electricity Board to build a 2,015 megawatt power plant in Dabhol, India.

(8) Among a clutch of pipelaying activities John Brown Engineering is contracted to lay by early 1995 a 30 mile 18-12 in. gas transmission line in the offshore Bombay High area. (In this area, a massive project is underway aimed at cutting gas flaring).

Pakistan

(1) **Turkmenistan - Pakistan Pipeline**

Argentina's Bridas Corp is to carry out a feasibility study on possible construction of a gas pipeline from Turkmenistan through Afghanistan to Pakistan. The line would be built in joint venture with Pakistani state-owned Oil and Gas Development Corp. Bridas, involved in gas exploration in Turkmenistan, has found gas reserves close to the border with Afghanistan. And Turkmenistan has plans to export part of its gas to Pakistan and other countries in South Asia.

Pakistan official sources in the petroleum and natural resources ministry have defended their government's decision to carry out a feasibility study on gas imports from Turkmenistan commenting that this did not mean the abandonment of plans to buy gas from Iran and Qatar and that it had not foreclosed its other options.

(2) The governmental cabinet committee on energy has given the go-ahead to gas related projects whose accelerated implementation is likely to boost fast dwindling energy resources in Pakistan. The major gas schemes are: the Dhodak development phase II; the Loti development scheme phase II; the Tando Adam development project phase II; the PCII scheme for systematic evaluation and approval of gas resources in Thar gasfield; and the provision of gas to villages and towns in the vicinity of gasfields.

(3) **Sui Gas Transmission Co**

Indus/Right Bank 311 mile gas plan remains under study. Sui Gas also is considering a 500 mile transmission line between Multon and Karachi.

The gas company has dropped plans to build a gas purification facility, but will stay with plans to build a 372 mile 16 - 30 in. line. Lower than expected production eliminated the need for purification facilities.

Other projects planned or under study include a 44 mile gas line between the Sui and Pirkoh fields.

(4) **Sui Southern Gas Company**

(a) **Sui Southern Gas Rehabilitation and Expansion Project (SSREP)**

Projects recently completed, under construction or planned are as follows:

- Kadanwari - Nawabshah: 75 mile, 24 in. line completed end-1994
- Nawabshah - Karachi: 180 mile, 20 in. line completed mid-1994
- Shikarpur - Lakarna: 50 mile, 20 in. loopline completed mid-1994
- IRBP - CEP, 67 mile, 20 in. loopline for completion in June 1995.

Background

India and Pakistan are both clamouring for gas. India is potentially the largest market and is the favourite of Middle East exporters. Indian demand is in excess of domestic production, about which more information is provided in the Special Feature at the end of this survey.

Similarly, the need to import gas is recognised, for the same basic reasons as India, in Pakistan where no significant find has been yet discovered although one the size of Sui, for historical reasons, cannot be totally discounted. National energy consumption is increasing at an annual rate of 7%-8% and the shortage of energy is constraining growth. Consumption per head in Pakistan is one-third that in Egypt and economic growth - 4% to 5% - is half that of China and Thailand. A disturbing aspect of the national energy consumption pattern over the past five years has been that while the share of gas has remained steady at around 37.5% and hydro has declined slightly from 16% to 15% as has coal from 7.5% to 6.5%, the share of oil has grown from 38.8% to 40.1% despite the fact that crude oil production has dropped by about 10,000 barrels a day from its 1991 peak of 64,000 barrels a day.

While plans to pipeline link the subcontinent and the Middle East are described under the section of this report dealing with the Middle East and Africa, and, other possibilities involving Turkmenistan are mentioned below, even a cursory glance at the map raises questions about the viability of some of the supply options now being aired (mainly by politicians and contractors). The likelihood of satisfactorily marrying commercial, economic and political viability factors seems remote despite the recognition that the fundamentals of some of the proposals appear realistic.

This part of the world is not the first, but simply the latest, to suffer from pipelineitis; drawing pen lines on maps in the hope that gas lines would soon follow. But lines on a map do not carry gas and will not be transformed into pipelines unless the pipeline economics and politics make sense. The notion of exports from Turkmenistan to Pakistan seems especially far-fetched, given that it would require transit through either Iran or Afghanistan. A route via Iran would be so long that it would be intrinsically uncompetitive - and would an Iran with gas export intentions of its own countenance transit of third party gas (or the exclusion of its supply)? A route through Afghanistan could be competitive on cost, but what about security?

The 1000 mile proposition from Qatar or Iran to Pakistan and the 600 mile distance (across deep water) between Oman and India do not seem unimaginable. The Algerian pipeline to Italy is, after all, around 750 miles from field to mainland Italy, most of which is an easy onshore route. The Maghreb line to Spain will cross a similar distance and involve a short subsea section. Supplies from Norway to Europe involve similar distances.

But big though they may be, the Pakistani and Indian markets must have difficulty, individually, in absorbing - quickly - the sort of volumes that the integrated system in Europe can accommodate by combining demands from several large markets with developed infrastructure.

The economics of transmission pipelines, where doubling the diameter multiplies the capacity by four and the cost by less than two, demand market engineering. No big pipeline project is commercially achievable without large volumes, quick build-up, good load factor and believable take-or-pay (largely in hard currency).

A quick look at the way in which Europe has secured successive tranches of long-distance gas shows that an obvious move would be for India and Pakistan to cooperate in providing the markets to underpin the economics of these long-distance pipelines. This may be obvious to economists but maybe not to politicians.

Economic needs do not often fit easily with political ones. But political needs in both India and Pakistan include securing gas imports to fuel growing economies. Because cooperation between the two is much more likely to yield viable joint import projects in sequence than separate ones pursued in parallel, the long term political merits of cooperation are clear to outsiders at least.

The achievement of large volumes is constrained by markets, not reserves, and to get the necessary volume threshold and the best deals for both, India and Pakistan owe it to themselves to join forces and use their combined market power. It is hard to see this happening soon.

India

(1) The Indian government approved in Spring 1994 Gas Authority of India Ltd.'s (GAIL) proposals to upgrade the 311 miles 36in.Hazira-Bijaipur-Jagdishpur (HBJ) gas pipeline (and install a $92.6 million LPG plant at Usar in Maharashtra). GAIL proposes boosting HBJ pipeline capacity to 1.169 bcfd from the current 637 mcfd. The Asian Development Bank sanctioned a $260 million loan for the $1 billion project, which is expected to be completed in 1998. The pipeline expansion is in line with Oil and Natural Gas Commission (ONGC) efforts to develop more gas fields in the western offshore and to reduce gas flaring there. Those programs are expected to boost gas deliverability to the Hazira terminal on the western coast to 1.435 bcfd from the current 700 mcfd.

It is to be noted that the project also provides for new gas terminals at Faridabad and Jagdishpur in Utta Pradesh (UP) and Bawana in New Delhi, all sites for new gas-based power plants. Improved terminals are to be built at Hazira, Bijaipur and Aonla. National Fertilizers Ltd and Indian Farmers Fertilizers Ltd are doubling their urea capacities at Bijaipur and Aonla respectively.

(2) Within (1) above, Engineers India Ltd, consultant to GAIL, has called tenders for laying about 310 mile of the $710 million 36 inch trunk pipeline from Bijaipur in central Indian state Madhya Pradesh to Dadri in northern state Uttar Pradesh (UP), including an 8 mile spur line to a power plan at Faridabad in UP.

(3) Completion at end-1994 of the second 152 mile (offshore) Bassein - Hazira (near Bombay) gas line in the Arabian Gulf included 79 miles of 42 in. pipe awarded under contract to Europipe GmbH of Germany.

(b) **Quetta Pipeline Capacity Expansion Project, Stage II (QPLCEP II)**

Projects under construction or planned are as follows:

- Quetta - Shaikh Mandah: 13 mile, 17 in. for completion December 1996
- Kolpur - Quetta: 19 mile, 20 in. loopline for completion in December 1996
- Jacobabad - Dumboli: 79 mile, 18 in. loopline for completion in December 1996
- Sibi - Dadhar: 19 mile, 20 in. loopline for completion in December 1996

(c) A distribution joint venture company has been formed 50-50 between Sui Southern Gas Company and British Gas to undertake installation of Gas Turbo Expanders at several locations within Pakistan's gas distribution system to produce electricity for resale.

(5) Privatisation of gas utilities

- Mari Gas is being privatised
- Sui Northern Gas Piplelines (SNG PL) - the Government expects offers for 26% of the company by strategic investors in early 1995 and a March flotation
- Sui Southern Gas (SSGCL) - the Government expects offers for 26% of the company by strategic investors in early 1995 and a June flotation.

(6) **Sui Northern Gas Pipelines Ltd** has an aggressive construction plan through 1997. The projects include:

- 26 miles of 16 in. loop line from Sikanderabad to Kot Addu
- 45 miles of 16 in. loop line from Chiniot to Bhuna
- 24 miles of 16 in. loop line from Faisalabad to Shahdara
- 16 miles of 18 in. loop line from Uch Sharif to Sutlej
- 100 miles of 18 in. main line from Sahiwal - Lhr
- 16 miles of 24 in. loop line from Shorkot to Toba Tek Singh
- 97 miles of 24 in. main line from Qpr (Rawan) to Sahiwal
- 50 miles of 30 in. main line from Qpr to Bhong
- 203 miles of 30 in. loop line from Sui to Multan

Bangladesh

(1) The country has substantial onshore reserves, with 17 fields found, and the government is keen to boost output of 580 mcfd of gas, 1,000 b/d of condensates and 150 b/d of oil from the five gas fields and one oilfield brought on stream. The offshore has been badly neglected but now the authorities have prepared a 17 block tender of mainly offshore acreage and petroleum policy has been liberalised.

(2) The country has 1,500 miles of gas pipelines planned or under study. The focus is on Titas Gas Transmission and Distribution Co's 139 miles of gas transmission system. The projects target industrial and economic growth. Pipe lines involved are:

- 27 miles of 12 in. line from Elenga to Tarakandi
- 35 miles of 24 in. line from Dhania to Mymensingh
- 77 miles of 24 in. line from Elenga to Ashunganj
- 270 miles of 2-14 in. feeder lines, service mains and distribution lines, together with ten meter and regulator stations.

The route crosses three major rivers, Meghna, Bhramaputra and Banar, which will be directionally drilled.

(3) 35 miles of 30 in. gas pipeline from Ashunganj to Bakhrabad is under construction. The pipeline is part of the Gas Infrastructure Development Project being done by Petrobangla and funded by the International Development Association. Work began in June 1994 with the pipeline becoming operational in July 1996.

Myanmar (Burma)

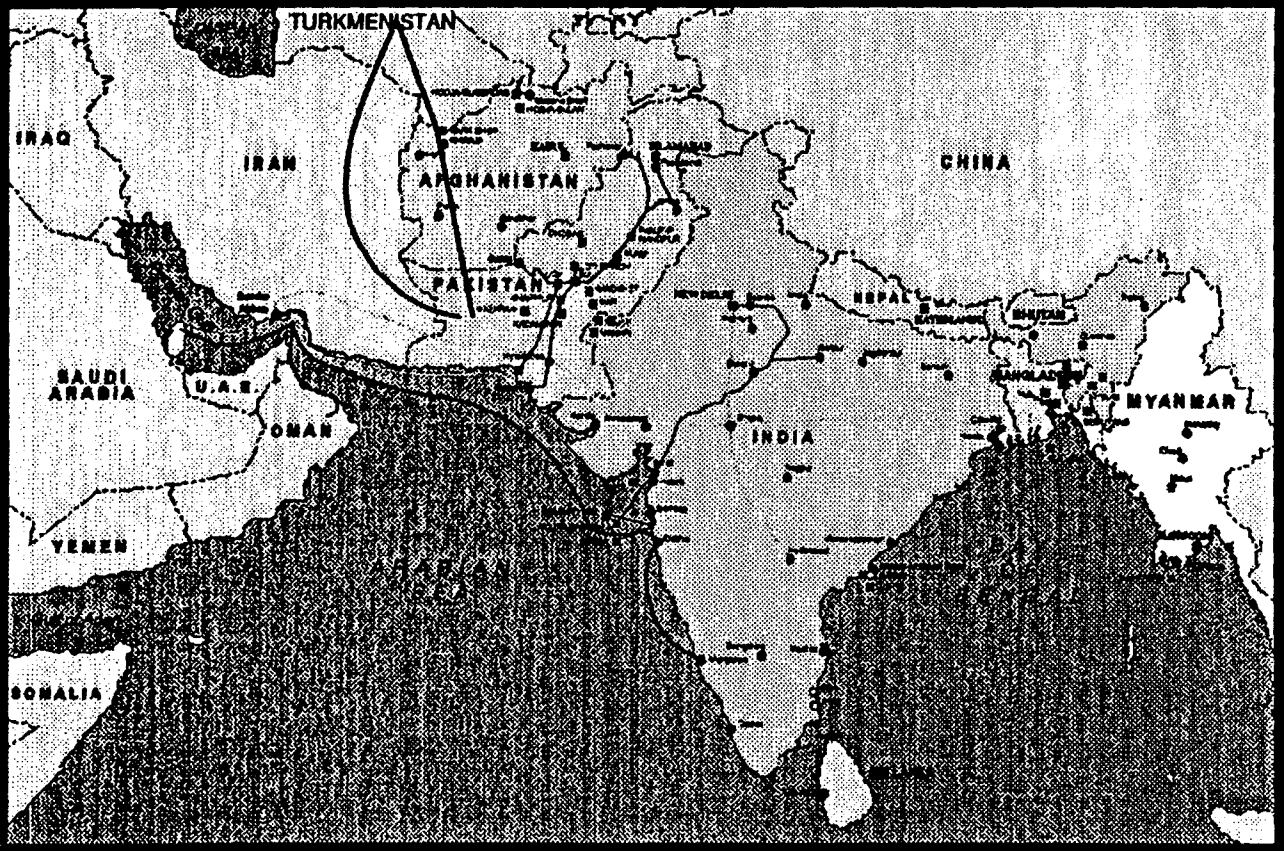
250 mile subsea line and 62 mile onshore line from Myanmar's Gulf of Matarban gas field to Bangkok. The field is scheduled to come on stream in 1998. The line may be extended an additional 242 miles to deliver gas to a planned 2100 MW combined cycle power plant south east of Bangkok. Total and Unocal are expected to jointly build the pipeline although no date for construction has been settled.

Difficult political, especially hostile guerrilla presence along the route, can be expected with this development.

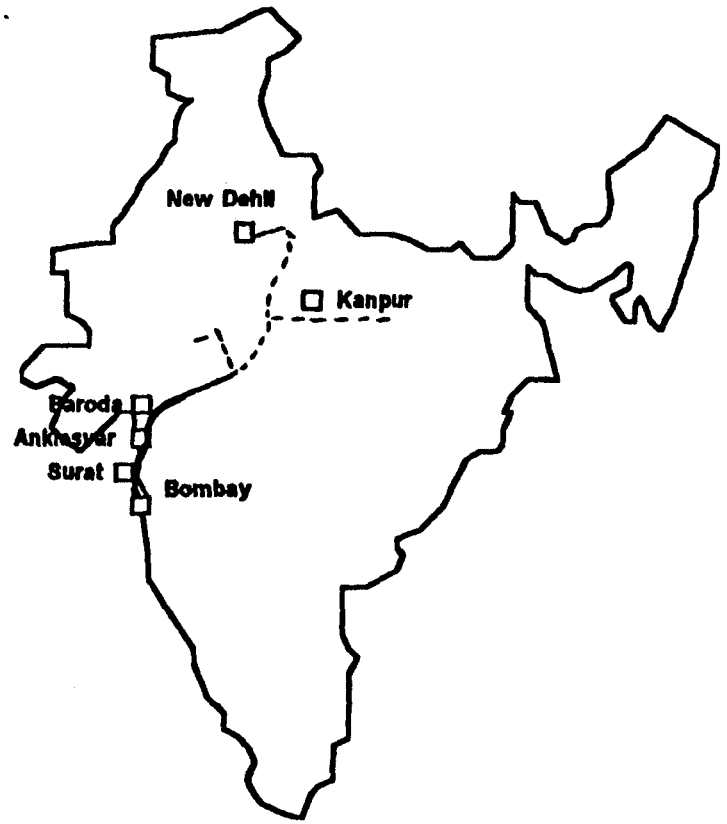
This project is more fully described in the Pacific Rim section.

INDIA & PAKISTAN

PROPOSED MIDDLE EAST PIPELINE ROUTES



INDIA GAS TRANSMISSION



SUI SOUTHERN GAS COMPANY LIMITED
GAS INFRASTRUCTURE PLAN

SSGC

PURIFICATION/COMPRESSION FACILITIES

LINE	LOCATION	COMPRESSION FACILITIES		PURIFICATION FACILITIES	
		EXISTING HP	PROPOSED HP	EXISTING	PROPOSED
ILBP	SUKKUR	4 UNITS, 6500 HP	–	–	–
ILBP	NAWABSHAH	4 UNITS, 6300 HP	–	–	–
IRBP	SHIKARPUR	3 UNITS, 17400 HP	*	CRF ***	–
IRBP	DADU	2 UNITS, 11600 HP	–	–	–
PGFIP	SUI	2 UNITS, 11600 HP	–	–	–
QNGP	SIBI	–	2 UNITS, 3600 HP **	–	–
BGFIP	HYDERABAD	–	–	LHF ****	–
KDNPP	KADANWARI	–	–	–	DEHYDRATION

* ONLY REMOVING OF EXISTING COMPRESSORS.
** 1 STANDBY.
*** CONDENSATE REMOVAL FACILITY .
**** LIQUID HANDLING FACILITY FOR PURIFICATION OF GAS BY REMOVAL OF CONDENSATE AND IMPURITIES.

QPLCEP–II
18"ø, 21 KM, Quetta–Sh.Mandah Pipeline
Completion : December, 1996
SHAIKH MANDAH
QUETTA
QPLCEP–II
20"ø, 30 KM, Kolpur–Quetta Loopline
Completion : December, 1996
SARIAB
KOLPUR
12"ø, 345 KM Quetta Pipeline
QPLCEP–II
20"ø, 30 KM, Sibi–Dadhar Loopline
Completion : December, 1996
GOKURT
DADHAR
SIBI
QPLCEP–I
Sibi Compressor Station
Completion : March, 1995
PIRKOH
18"ø, 70 KM Pirkoh Gas Pipeline
Capacity 120 MMSCFD.
DERA BUGTI
DAMBOLI
QPLCEP–II
18"ø, 127 KM, Jcb–Dumboli Loopline
Completion : December, 1996
SUI
JACOBABAD
QPLCEP–I
18"ø, 34 KM Shk–Jkb Loopline
Capacity 60 MMSCFD.
R S–1
G2
GUDDU
N
SHIKARPUR
20"ø, 60 KM Shk–Lar Loopline
Completion : June, 1994
SEE NOTE–1
ROHRI/SUKKUR
LARKANA
16"ø, 559 KM ILBP Pipeline
Cap: 120 MMSCFD
18"ø/20"ø IRBP System
Capacity 280 MMSCFD
KADANWARI
DADU
20"ø, 108 KM IRBP–CEP Loopline
Completion : June, 1995
SEE NOTE–1
24"ø, 122 KM Kadanwari pipeline
Capacity 140 MMSCFD, SEE NOTE–1
Completion : September, 1994
SEHWAN
NAWABSHAH
KARCHAT
HYDERABAD
JAMSHORO
KOTRI
SMS
12"/18" ø, 130 KM BGFIP Pipeline
Capacity 100 MMSCFD .
KARACHI
BADIN BLOCK
20"ø, 288 KM N.Shah–Kcy Pipeline
Capacity 140 MMSCFD, SEE NOTE–1
Completion : March, 1995
ARABIAN SEA

LEGEND

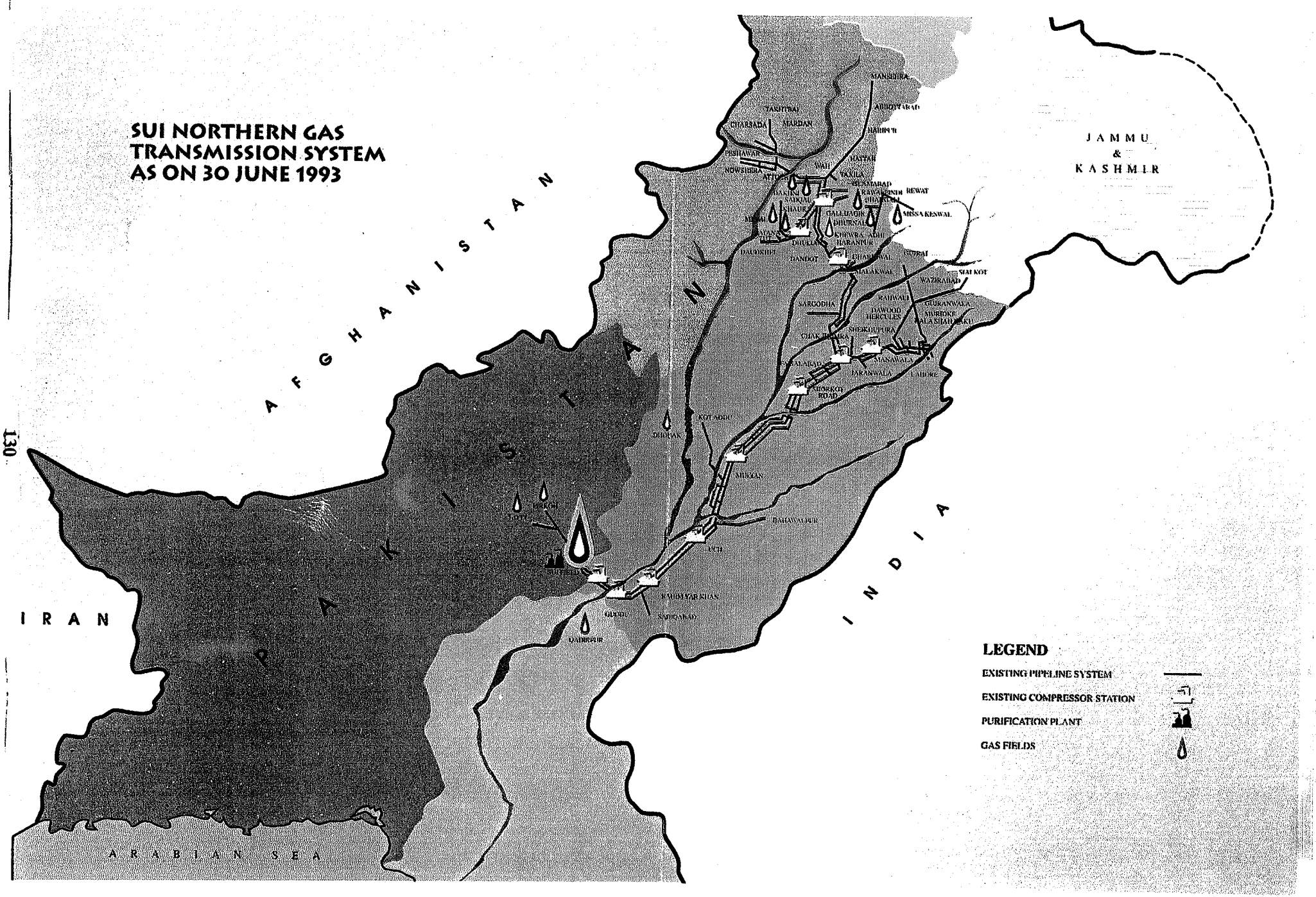
- EXISTING PURIFICATION PLANT
- EXISTING SYSTEM PIPELINE
- EXISTING COMPRESSOR STATION
- EXISTING HEAD QUARTER STATION
- CONDENSATE REMOVAL FACILITY
- LIQUID HANDLING FACILITY
- PROPOSED PURIFICATION BANK
- PROPOSED SYSTEM PIPELINE
- PROPOSED COMPRESSOR STATION
- DEHYDRATION UNIT
- GAS FIELDS

QPL TRANSMISSION CAPACITY

ORIGINAL CAPACITY (12"ø QPL)	: 28 MMSCFD
PLANNED CAPACITY INCREASE	
– PHASE–I	: 32 MMSCFD
– PHASE–II	: 40 MMSCFD
TOTAL CAPACITY	100 MMSCFD

NOTE–1 : Under implementation as a component of Sui Southern Gas System Rehabilitation and Expansion Project (SSREP).

SUI NORTHERN GAS TRANSMISSION SYSTEM AS ON 30 JUNE 1993



Background: Gulf Gas

The Middle East - defined as the region from Iran to Egypt - according to conventional wisdom possesses 31.5% of the world's known gas reserves. Yet it produces barely 5 % of world output. With gas seen as a clean fuel that is increasingly favoured for environmental reasons, a number of countries in the region - most notably Qatar, Iran, the United Arab Emirates (UAE) and Oman - are looking to develop their gas resources with a view to shipping them overseas as LNG or piping them directly to new markets.

However, a new study delivered in mid-1994 by the Centre for Global Energy Studies (CGES) claims that reported reserves of natural gas in the region are likely to be significantly underestimated. The claim runs directly counter to the traditional view that the Middle East has always overestimated its reserves either for political reasons or because reserves could not be produced economically at current gas prices.

According to the CGES, oil reserves in the Middle East are more than twice as large as gas reserves on an energy equivalent basis, yet in the world as a whole oil and gas reserves are roughly equal. Research by the Centre also reveals that the ratio of non-associated to associated gas in the Middle East is far lower that in most other regions of the world. Non-associated gas reserves are about twice the size of the reserves of associated gas, whereas in the world as a whole they are 5.7 times as great.

It is only recently that many of the Middle East countries have begun exploring specifically for gas, according to the CGES. In 1992, the Middle East produced just 0.3% of its gas reserves, the lowest proportion in the world. (This compared to 1.4% in the former Soviet Union, 3.5% in Western Europe and 8.6% in North America). The CGES predicts that in the future the Middle East is likely to account for a far larger share of the world's gas resources than the 31.5% it currently holds. However, there are still many barriers to development. Domestic consumption, for example, is very low - indeed it is less than the combined consumption of France and Germany.

The CGES also forecasts continuing problems for the Middle East in accessing Western gas markets noting that 'Natural gas prices in Europe will have to rise... but this is unlikely as long as gas prices remain linked to those of oil'.

The most significant developments have taken place in countries where foreign investment has not been ruled out, according to the CGES. The UAE, Qatar and Oman seem to be leading the way, principally through a series of proposed LNG and/or pipeline projects to supply Asian markets. But the main topic is an ambitious plan to supply Europe with natural gas from the Persian Gulf. The route has not been determined and initial estimates have the project costing about $15 billion. Once the proposal becomes better defined, the Gulf states could throw their support behind the project in an effort to compete for the European gas market.

Specifically with regard to Iran, with the announcement of his second Five Year Plan, announced in mid-1994, the country's President Rafsanjani promised once again to develop the

country's natural gas industry. Yet a reduction in hydrocarbon export earnings combined with a worrying foreign debt repayment bill, has put investment funds at risk, turning Tehran's investment planning into little more than a wish list in the eyes of many commentators and observers of the region.

Nevertheless, as oil prices fluctuate, gas is coming into its own, increasingly as the 'green' fuel of choice. It is seen as environmentally benign and demand is on the rise. Interest in gas is strongest in mature energy markets such as Europe and Japan where air quality concerns are moving up the political agenda. Fresh doubt over the long-term growth in demand for oil has alerted the Gulf states to the huge potential of their gas reserves. With the exception of the master gas system in Saudi Arabia and Abu Dhabi's exports to Japan, most Gulf gas has been re-injected. But, with a shift in demand from oil to gas, several states are starting to exploit gas directly. The doubling of Abu Dhabi's export capacity is already nearing completion. But the most startling development is Qatar where, after years of idle talk, a major gas export scheme is finally happening. This and other more speculative emerging possibilities in the region are described below under items (1) to (6). There is considerable overlap between the various schemes reflecting, often, national power politics as well as regional aspirations.

(1) Oman-India

Oman's bid to join the ranks of gas exporters - total reserves are now put at 21tcf - by the end of the century is split between two competing schemes being examined by the government. One involves exporting 5 million tonnes a year of LNG by tanker while the other re-envisages piping gas directly to India. Both projects would require collosal investments.

The gas will come from three deep fields in central Oman, Saih Rawl, Saih Nihayda and Barik, which together have reserves of 11.9 tcf. Plans for their development are already firmed up. This will entail investment of $2,000 million under the management of Petroleum Development Oman (PDO) to build production facilities, a gathering system and a gas processing facility with a capacity of 775 mcfd nearby. The package will also include a 250 mile pipeline from the processing plant to the coast at Bimma, near Dur.

The major international pipeline scheme is to build a $5 billion deep-sea line to the coast of Gujarat in India to take 2000 mcfd of gas. Widely regarded as the world's most ambitious pipeline project, the original plan was to begin laying the twin 24-inch diameter pipe at the town of Sur on the Omani coast and then cross the Arabian Sea in a roughly south easterly direction, crossing the Murray Ridge and circumventing the Dairymple Trough before turning north east across the Indus Fan to the Indian coast.

The Oman Oil Company, which is building the pipeline, awarded Racal Survey the contract to make a geotechnical and geophysical assessment of the 680 mile route which, in places, reaches depths of around 11,000 ft. This is four times deeper than any pipeline has been laid before and will demand solutions to a range of technical challenges which should open up a new era of deep water operations for the offshore industry.

As a result of the difficult seabed conditions encountered by Racal Survey a major revision of the proposed route for the Oman-India pipeline has been prompted.

Essentially this calls for a new coastal starting point at Ra's al Jifan, well south of Sur, from where the line would run 150 miles south east to the Omani Scarp before turning east to run to a point where it joins the original route to Gujarat.

The Oman Oil Company is confident that, barring unforeseen obstacles, the pipeline project will maintain its present schedule. It is intended that design packages should be in the hands of the bidding companies at the end of 1994 and that the construction contract should be awarded mid-1995. Active construction is expected to begin in mid-1997 with first gas of up to 2 billion cubic feet being pumped daily to India by mid 1999 at an estimated cost of $2.8 billion. Phase 2 (pipeline twinning) costing $2.2 billion would go onstream in 2001. Partners in the venture include Omani Oil Co, McDermott, Bechtel, Engineers India, Saipem and Snamprogetti.

However, it has to be stated that there are still many who see the scheme as fanciful and believe - contrary to Omani governmental views - that financing of the pipeline scheme may not prove possible. Some reports say the scheme is on hold.

For information, the development of the offshore Kukha gas field in northern Oman, being carried out by International Petroleum Bukha Ltd (subsidiary of Vancouver-based International Petroleum Corp) includes a 22 mile 16in. line from the field to shore near Khor Khuwair.

(2) **Iran - India**

The prestigious $5 billion Indo-Iranian pipeline to supply natural gas to India is reported to have made real progress by the end of 1994 with technical experts from both India and Iran deciding to float global tenders at that time. The pipeline connecting Bandar Abbas in Iran with a port site in the western Indian state of Gujarat reportedly evinced a wide response with some half a dozen multinational consortia submitting concrete proposals and some offering to meet the bill of $5-6 million for preparing the detailed feasibility report. The feasibility report was expected to be completed by November 1994 after which the tender formalities would be looked into and subsequently work on the project proper would begin which would take three or four years to conclude. It is believed that choice of the offshore route has been narrowed down to one or two possibilities with feasibility and costs the sole criteria for a final decision. The proposed offshore route will involve laying of pipes up to a depth of 600 feet in the entire stretch.

Both the Indian and the Iranian sides are according utmost importance to the involvement of domestic firms in the project given that Iranians have the expertise in laying the pipeline and Indians the technology to manufacture pressure pipes for use in seabeds. Considering the massive availability of natural gas in Iran (700 tcf) and the feasibility of the pipeline project it is expected that World Bank and international financial institutions will finance the project. For the record, nearly 80% of the Iranian population gets domestic gas through pipes. The country supplies gas to Europe via Azerbaijan through an offshore line and is also planning to lay an on-shore pipeline through Turkey.

Iran/Pakistan. In January 1995 Pakistan signed a contract with Iran to buy 1.6 bcf/day of gas to reduce the furnace oil import bill and contribute to alleviating energy and environmental problems. At the same time it was announced that a pre-feasibility study on a proposed gas pipeline was nearing completion. Previously it has been understood that there was a MOU between the two countries for a 1,170 mile pipeline from Iran's Kangan gasfield to Pakistan. The line would run 710 miles in Iran and 460 miles in Pakistan where it would be linked to the national transmission network at Pishin in southern Baluchistan. Estimated project cost has been put at $7 billion, possibly funded from Oman and Qatar. Study work is in the hands of BHP and the National Iranian Gas Co.

(3) Qatar - Pakistan and India

During 1994 some progress was made on the proposed pipeline for natural gas from Qatar to Pakistan and perhaps India, although references to the Indian possibility have become less evident. India is interested in accessing Gulf gas, but this is only likely if the Iran - Pakistan leg of the pipeline runs offshore and is extended past the Karachi port area down the coast to northwest India. This is a long-way off because of political problems between Pakistan and India.

An important development was the decision by Qatar to press ahead with its $8 billion project to develop the world's biggest gas field. Mobil, which owns 30% of the Ras Laffan company, early in 1994 drilled its first well since it joined the Qatari General Petroleum Corporation (QGPC) and stated that engineering and construction work would now be able to proceed according to plan; the field's proven gas reserves, of 250 tcf, made it the biggest gas reservoir in the world. When the project is completed in 1997 Qatar will be able to export about five million tonnes of liquefied gas a year mainly to South Korea and Taiwan. North Field development plans include a 51 mile 32in. line to feed the Ras Laffan LNG plant.

Specifically regarding the scheme to pipe Qatari gas to Pakistan and, in the process, create the nucleus of a regional gas pipeline network, the $3.2 billion scheme (995 miles of 48in line) put forward by the Sharjah-based Crescent Petroleum, is aimed at supplying 1.6 bcf/day from the giant North Field to Pakistan via an onshore section across the UAE to Fujairah and then a subsea route along the continental shelf off Iran to the Pakistani ports of Gwadar and Gadani. Crescent, which says it has secured approval from the relevant governments, has now been joined in the venture by two other equity partners, Trans Canada Pipelines and Brown and Root - the latter also being appointed, the project's turnkey contractor. The 40 inch, 1000 mile pipeline, of which only 60 miles would be onshore, is projected for completion in 1998 on the basis that project financing is settled by mid-1995 so building can start in 1996. Onshore facilities include compression stations in Qatar, the UAE and Pakistan. The financing will be covered by private investment, essentially by the project sponsors, with cost recovery through fees collection from users. Development of the project has coincided with reports that the UAE, Qatar and Oman are considering the possibility of linking up their gas gathering systems. The problem has recently come into focus as Dubai ponders how to secure a fresh source of gas for reinjection into its declining oil fields. The logical solution, proposed by Conoco as a field operator, is for gas to be pumped in

from a neighbouring Iranian field, Sirri. But this poses political problems, hence the interest in developing alternative approaches.

On a broader canvas, the Crescent scheme - expanded to become the Gulf-South East Asia Gas (GUSA) project - envisages a pipeline with capacity of 3.8 bcf/day, of which 2.4 bcf/day would (eventually) be supplied to Pakistan, 800 mcf/day to Dubai and 400 mcf/day to the northern emirates.

(4) **Oman - Pakistan**

In spring 1994, reportedly, Pakistan Prime Minister Benazir Bhutto and Omani officials discussed a plan to establish a 1000 mile regional gas pipeline although no agreement was signed. The pipeline would link Qatar, Iran, Oman and Pakistan and discussions had been initiated with Iran and Qatar while contact had been made with Turkey about financing the project which would cost at least $3,500 million. The plan is unrelated to the scheme for a regional pipeline sponsored by the Sharjah-based Crescent Petroleum (see (3) above).

Arising out of the Pakistan - Oman discussions a feasibility study for the regional pipeline was agreed with the costs being shared equally between the two countries.

Latest official estimates are that Pakistan's gas requirement will rise to around 4 bcfd by 2000, while domestic output is not expected to exceed 2.7 bcfd, thus leaving a gas supply gap of some 1.3 bcfd. However, Pakistan is still keeping its gas import options open in a lot of directions.

(5) **Iran - Europe**

Iran has initiated a detailed study (following completion of a preliminary feasibility study) with the help of a European consortium on an ambitious pipeline to carry Iranian natural gas to Europe. It is expected that the consortium which includes France's Gaz de France would build the transcontinental pipeline if the project proved feasible. Although the Iranian government and the French state-owned gas firm were the main members of the consortium it is known that firms from Germany, Spain, Slovakia, the Czech Republic and Austria -- including Germany Ruhrgas and Spain's Enagas -- had either joined or expressed interest in such a grouping. It is understood that the planned pipeline would pass through Turkey, Bulgaria, a number of other European countries and terminate in France. Pipeline capacity would be 1.6 tcf/year and the cost estimate between $10 and $20 billion.

Iran, with gas reserves second only to Russia, is keen to develop ways of getting it to markets but faces both a shortage of funds and an attempt by some western nations to deny it financial and technical help.

Within Iran itself, completion was reported in spring 1994 of the following projects:

(a) a 200 mile pipeline from Esfahan to Yazd which comprises two separate sections, starting from Kuhpayeh and after crossing the regions of Na'in, Haqda, Ardakan, Meybod, Ashk-e Zar and Zarch, reaches the city of Yazd. The housing

development of the oppressed and the war-disabled foundation of the Islamic revolution handled the project under the supervision of the Iranian national gas company at a cost of eight billion rials and $20 million in hard currency.

(b) a 35 mile gas pipeline between Aligudarz and Miandash.

(c) the project to provide gas to the town of Borujerd.

(d) work on the Dorud-Korramabad pipeline.

Construction is reported underway on the Iran-Armenia pipeline but no further information is available

For information only, Iran proposes an ambitious internal network of pipes to ring the country with spurs that would take gas in from the Gulf to the southwest and from Central Asia to the northeast and to push it out to Turkey and Europe in the northwest and to Pakistan and India in the southeast.

(6) **UNIDO Middle East Trunkline Loop**

Japan's Chiyoda Corp has asked Mitsubishi Corp and Mitsui and Co Ltd to join a $10 billion gas project in the Middle East following Chiyoda's completion of a feasibility study on a gas trunkline loop over Middle East countries with the UN Industrial Development Organisation (UNIDO). A second study was due to start later in 1994 involving Japanese and European concerns along with Middle Eastern countries. Chiyoda hopes to complete the 4,300 mile line by 2010. It is expected to enable supply of some 20 million tonnes (mt) of natural gas a year to Japan and other Asian countries and a further 11 mt to Europe.

The second study will assess future LNG demand in Japan, China, Taiwan, South Korea and Thailand; and will be joined by Italy's ENI, BP and France's Total, in order to assess future demand in Europe.

As currently conceived, the pipeline would be a loop travelling through Iran, Saudi Arabia, Qatar, Oman, Jordan and Syria. It would be able to deliver natural gas to Europe, possibly through an extended line across northern Africa to Morocco and then under the Mediterranean Sea; and, would also carry gas to a proposed LNG plant in Oman for shipment to Japan and elsewhere in Asia.

The study suggests the project could be finished by 2010 but its final form and scheduling depend heavily on decisions to be made after new participants join. And, clearly, this is a competing proposal to that described at item (5) above.

Abu Dhabi

(1) Abu Dhabi National Oil Company (ADNOC) has contracted international companies Saipem and Snamprogetti to build a $150 million gas pipeline from Bab to Taweelah via Maqta. The project involves building a 77 mile 42in. pipeline between Bab and Maqta

and a 35 mile 36in. pipeline between Maqta and Taweelah where fuel will be provided for a power plant being built by ABB. Completion is mid 1995.

(2) Projects being progressed (which have been under consideration for some time) are:

- 66 mile 16in. gas transmission line from Habshan to Ruwais, scheduled for 1995 completion
- 78 mile 36in. gas transmission line from Habshan to Ruwais, scheduled for 1995 completion.
- 25 mile 18in. gas transmission line from Bab to Miffa, scheduled for 1996 completion.
- Gas gathering lines are scheduled for construction that eventually will reach from Bab to Habshan
- At Habshan, Bechtel International is providing design and construction management on $13 billion onshore gas facility. Work includes a new gas processing facility, compressors, condensate storage tanks and pipelines totalling 155 miles.

Egypt

(1) In the long term Egypt cannot be ruled out as a gas exporter to Europe. In December 1992 Italy's ENI opened up the possibility of a gas line from Egypt to Italy through Libya. This would, of course, be an ambitious scheme from inception fraught with political difficulties. Moreover, Egypt has traditionally resisted gas exports. Domestic demand for gas climbs fast as Egypt converts power stations from oil and there has been lurking doubt about the adequacy of reserves. However, 1993 saw reserves increase by 75% and Egyptian General Petroleum Corporation (EGPC) is looking for this to increase substantially and hopes that exports are only a few years away. Israel has already been courting supplies.

The springboard for gas export hopes is the series of discoveries in the Nile Delta area, already a substantial gas-producing region onshore. It is the area to watch if Egypt considers pipeline exports to Europe.

(2) Egypt's pipeline infrastructure is on the eve of development, following an agreement between Amoco, IEOC and the Egypt Gas Company. All three companies have signed a memorandum of understanding to form the country's first private natural gas pipeline firm. The $300 million joint venture will initially focus on two projects: an export pipeline to the eastern Mediterranean countries (see below) and a pipe conecting natural gas discoveries in Egypt's Western Desert with the country's internal gas distribution network (see below). Egypt will hold a 34% stake in the venture, leaving Amoco and IEOC each holding 33%. The company, which awaits final approval from the Egyptian authorities could be up and running as early as mid-1995.

(3) The Egyptian government has taken the decision to export gas. The most likely prospect is a 300 mile 2bcf/year capacity pipeline to Israel and Palestine, a project discussed by Israeli and Egyptian ministers over the last year but which will require further progress in the Palestinian peace process before it can be put into effect. The pipeline would run from the gasfields in the Nile Delta and the Mediterranean to Israel and Lebanon via Gaza where a 200 MW power station would be built. Cost estimate is $800 million.

(4) Egypt has also received a request from Turkey for gas and in 1993 a senior Egyptian gas official mooted the idea of the eventual sale of gas by pipeline to Greece. Such a project seems premature unless further reserves are discovered to take the total above the current 21 tcf level. In any case, gas exports will not start before 1998. Meanwhile the principal advantage Egypt expects to derive from increased gas output is the release of extra oil for export - the government hopes for up to 100,000 b/d by 1997.

(5) The European Investment Bank is making a $25 million loan to modernise and expand the gas distribution system, particularly in Cairo. The objective is to supply an additional 70 mcfd throughout Egypt to some 235,000 homes and 5,000 commercial and industrial customers. In this regard, following the commencing of production from the Zaafarana Field (formerly the Warda field) it has been announced that British Gas has secured a contract to provide managerial and specialist support to upgrade the transmission and distribution system for the country's gas industry.

(6) Talks among Shell, Repsol, Norsk Hydro and Agip regarding construction of the gas line from Egypt's Western Desert to a tie-in with Egypt's national grid have proven inconclusive. The four companies reportedly have significant finds in the desert, but say it is too early to discuss a pipeline. A feasibility study is in hand for a line from the Khalda licence to Sidi Kirir, between Alexandria and Al Hamra.

(7) Egyptian General Petroleum Corporation (EGPC) projects

- 119 miles 16in. gas line from Shokier to Suz. Under construction; contractor, Petroject.
- 103 miles 18in. line from El Eaafrana to Kurimat. Under construction for completion end 1995; contractor, Petrojet
- EGPC and Shell Winning are still looking at a 1996 in service date for a 186 mile gas line in the Amiriyah region. Like many projects in the region, financing remains a concern.

Iran

(1) According to a report from Scottish Enterprise National there is plenty of work for oil and gas contractors in Iran. The report indicates that companies operating in the country require a wide range of supplies including wellhead equipment and valves, pipelines and pigging facilities, pumping and compression equipment and stationary or mobile fire-fighting gear.

(2) Gaz de France in an effort to secure a new gas supplier is investigating the feasibility of working out an LNG agreement with Iran. A decision is expected during 1995, but it may come later. Such a project, however, would spur additional construction activity.

Israel

(1) As previously reported above, Egypt and Israel have exchanged letters of understanding to begin detailed work on linking the two countries' national power grids and build a $800-$1 billion pipeline to supply Israel with Egyptian gas. These developments mark an early step in what Israel hopes will be a big peace dividend from Middle East regional integration. The study work will be financed by the European Union (EU). The linking of regional electricity systems could save Israel $200m and Egypt $78m by eliminating the need for parallel power lines. Israel also hopes to include Jordan, Turkey and Syria in a regional power grid as soon as there is a (more comprehensive) Mideast peace agreement. Under the potential gas supply deal a 300 mile pipeline would be built by Italy's ENI from Egyptian Nile Delta offshore gas fields to Israel, passing through the Gaza Strip, which could also be supplied with Egyptian gas, and on to Tel Aviv, Haifa, and possibly later to the Lebanon. Israel hopes to agree a supply contract under which Egypt would pipe up to 2m tonnes of natural gas annually for 25 years, mainly to Israeli power plants. The $1 billion project may be funded in part by the EU. An international energy company, approved by both Egyptian and Israeli Energy Ministries, will undertake a study. Egypt has said it has insufficient natural gas to export, but potential discoveries might provide the necessary reserves.

(2) During 1994 officials of the Suez Canal Authority expressed concern at the possibility of gas exports from Gulf states. The worry was not that supplies might be provided - from Qatar - for Israeli domestic use but rather that a pipeline for Israel might be used to export gas to Europe.

Jordan

The Ministry pf Energy and Mineral Resources is considering a 217 mile gas transmission line from the Al-Risha field to Azzarqa.

Syria

(1) Syria is looking to gas to fuel new power plants but is hampered by the fact that its resources are generally far from its population centres. There is considerable potential for developing gas-based petrochemical industries but further economic liberalisation and progress towards a peace treaty with Israel will almost certainly be required before Damascus can secure the requisite foreign investment.

(2) Gas utlisation plans are advanced for:

- a gathering system for the Audah, Kahtaniyah and Lailak fields that will extend to a 150 MW power station. Foreign firms will handle engineering and procurement and SPC will be responsible for construction. Construction will require a year to complete once plans are finalised.

- gas deliveries from the Omar and Tanak fields to power, upon completion, the Tishrin power station; converting the Mahrada power station from fuel oil to gas; and, completion of a 273 mile 18in pipeline.

(3) International companies have bid for a number of new gas development projects. They include:

- Homs junction to Jandar gas pipeline - Al Furat Petroleum Company has received bids for the construction of this 15 mile, 18 in. diameter pipeline which will provide gas for the 600 MW Jandar combined cycle power station being built by Japan's Mitsubishi Heavy Industries. Bidders for the estimated $10 million - $15 million contract included Turkey's Attila Dogan and Brown and Root of the US.

- Palmyra region gas pipeline supply - the Syrian Petroleum Company has received bids for the supply of pipes for the development of gas fields in the Palmyra area. The companies who tendered included Mannesman and Kloeckner Industrieanlagenbau, both of Germany, and Sumitomo Corporation and Itochu Corporation, both of Japan.

- Expansion of the Homs pipeline in the northeast of the country. Financing will be by Arabian Petroleum Investment Corp for $250 million. The project will include a gas gathering and treatment center at Suwaidiyah, expansion of another treatment site and the pipeline expansion.

United Arab Emirates (UAE)

Germany's Pipeline Engineering is under contract with Emirates General Petroleum Co. to design a 50 mile gas line from Sharjah to Dubai. The company also is studying a 217 mile gas and NGL line from offshore Bukha field to Sohar.

Yemen

Feasibility studies are underway by the Yemen government to build a 372 mile gas line from the offshore Alif field to landfall in Yemen.

AFRICA

Algeria

(a) For Sonatrach

- 1400 miles gas line from Algeria-Tunisia border to Cape Bon, on the northern coast of Tunisia across the Mediterranean to Sicily and then to Minerbio, Italy. (Expansion to the Transmediterranean Gas Pipeline, will roughly run parallel to the 10 year old first Trans Med pipeline). Will increase exports from 430 bcf/year to 860 bcf/year. Completion; 1996 (Companies involved; TMPC/TTPC/SNAM)

- 90 miles, 8-14in. gas line from Rhourde Chouff and Rhourde Hamra gas field development in progress. Contractor: Snamprogetti. Completion: 1994
- 400 miles, 42in. gas line from Hassi R'Mel to Skikda under construction. Contractor; Spie-Capag
- 330 miles, 48in. gas line to connect with Morocco and Cordoba, Spain. Completion: 1995/96. (Maghreb Europe Pipeline Project will be onshore and offshore. First phase is 338 mile section almost entirely in Morocco with pipeline from Algeria's Hassi R'Mel fields to Seville, Spain, crossing the Straits of Gibralter on the route. Estimated cost is $1.5 billion. Sonatrach has awarded a contract worth $456 million to Bechtel to build the Algerian section. Completion is expected in 1995. Total line length will be 850 miles. Partners are GdF, Ruhrgas, Enagas, Gas de Portugal, Sonatrach and the Moroccan SNPP. (See also Morocco below and under Europe for further details).

(b) For Sonelgaz

- 300 miles gas line from Hassi R'Mel gas field in Algeria to the Moroccan border. Proposed. Completion: 1995.

Libya

(a) Information is being gathered relating to Italy's ENI proposal for 3,278 mile gas network in North Africa to connect gas rich Libya and Algeria with Morocco and Mauritania with an eventual goal of making large volumes available to Europe. Even with all data in hand, the project falls into the slim possibility category. This line would extend from the Sirte Basin in Libya west to Mauritania, eventually expanding its reach eastward through Egypt on to the Arabian peninsula for access to export facilities.

(b) Despite UN sanctions Libya has long term ambitions to export gas by pipeline. In early 1994 the National Oil Corporation and Italy's Agip signed a gas production agreement for the offshore concession NC 41 which may bring the plan closer to realisation. The two sides completed a feasibility study on developing the field in 1993, which included the possibility of building a 350 mile gas pipeline to Italy. Total development cost has been conjectured at $10 billion.

(c) Libya is studying a 416 mile line from Al Brika to Khoms.

Madagascar

The government is still studying a 220 mile gas line from offshore West Manambolo field to the mainland.

Morocco

Construction work is continuing on the Moroccan portion of the Maghreb-Europe pipeline. The line will ultimately stretch from Algeria's Hassi R'Mel gas field to Cordoba in Spain. The Moroccan portion consists of 48in. pipe and runs some 340 miles from the Algerian border to Tangier. The pipeline will supply gas to Spain and Portugal and eventually to France and Germany.

Mozambique

A 560 mile, 16-24in. pipeline will be built from a gas field in Mozambique to markets in south Africa, with additional laterals being considered. The line, sponsored by Mozambique's national oil and gas company ENH and Sasol Ltd of South Africa, is expected to cost between $400 million and $500 million. The proposed pipeline will stretch from the Pande gas field, located about 375 miles northeast of Maputo, to Secunda, about 60 miles east of Johannesburg. About two-thirds of the route will be through Mozambique and the remainder in South Africa. Two spur pipelines are being studied, a 385 mile line from Ressano Garcia to Durban and a 335 mile line from Badplaas in the Transvaal with a lateral to Maputo. The Pande field's reserves of 1.7 tcf are expected to meet market demand for 20 years. Sasol is responsible for feasibility study work and also for construction. Other participants in the venture are Enron and Pluspetrol International of Argentina.

Nigeria

(a) Saipem is building a 54 mile, 14 and 24in. gas line in the Ikot Etetuek area; engineering was handled by Snamprogetti.

(b) Nigeria LNG Ltd wishes to install a 136 mile, 20-36in. gas transmission and gathering system while Snamprogetti is providing engineering services for the Bonny Island to River State line.

(c) Economic Community of West Africa continues its review of a 1,100 mile gas transmission network that would originate at Nigeria's Escravos River and pass through Niger, Benin, Togo and Ghana. Estimated cost is $2.8 billion.

South Africa

Soekor is looking at a 248 mile transmission line from offshore gas fields to onshore station at Mosselbaai and on to Cape Town.

Tanzania

137 mile pipeline. Will link an offshore gas field to a 100,000 Kw electric power plant at Dar es Salaam. Estimated cost $200 million. TransCanada and Ocelot are involved.

Tunisia

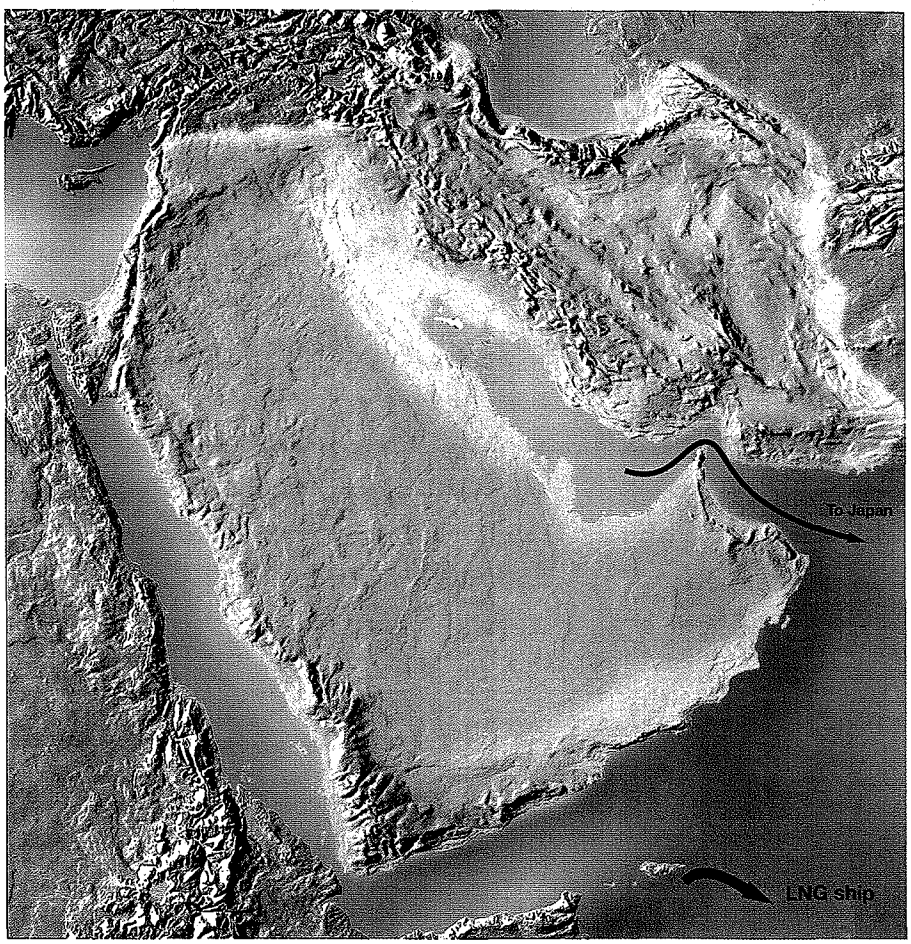
(a) Houston based MPC International, Inc. has been awarded a contract by British Gas Tunisia Ltd. to perform construction management services for the Miska Project in Tunisia. The project will include some 78 miles of 24in. pipeline for sour gas service. Nearly 76 miles will be laid offshore the North African country with a landing point near Sfax. Water depth reaches 200ft. Andrews Palmers & Associates is providing engineering services for the project, which is scheduled for completion before the middle of 1995.

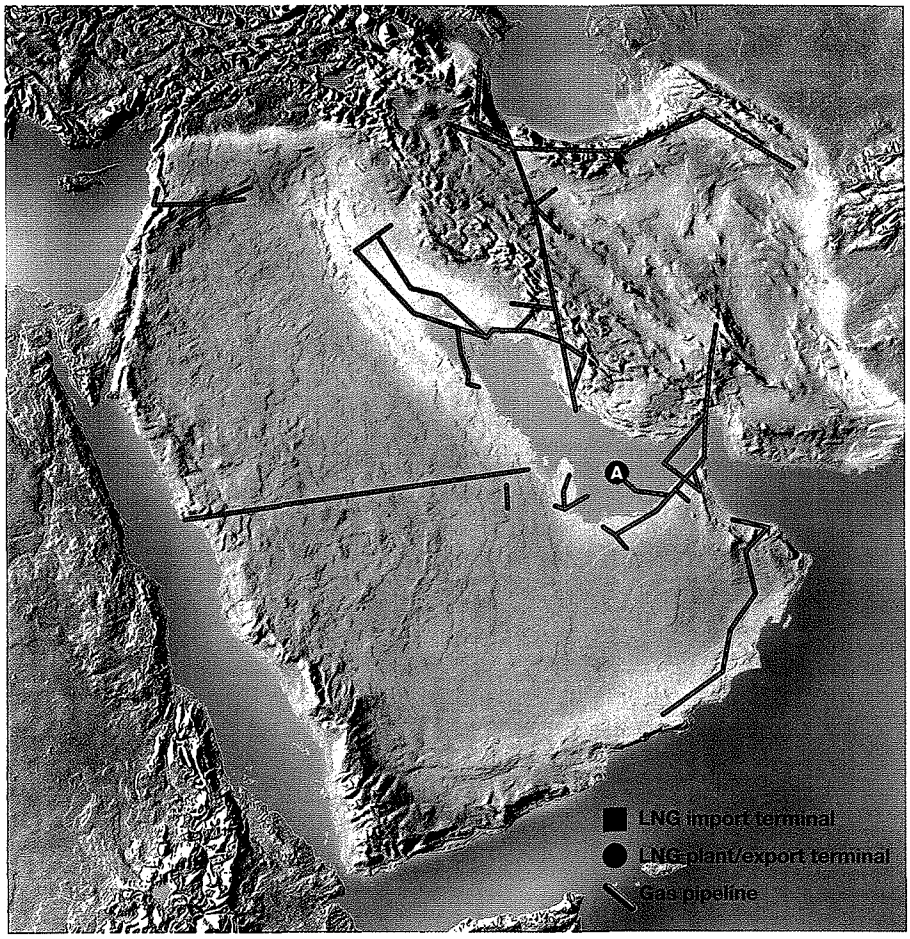
(b) Saipem is working on the Tunisian segment of the Trans-Med loop. The section, 230 mile, 48in. will move Algerian gas through the country's Cap Bon peninsula. Scheduled completion is 1995.

(c) On behalf of state electricity firm STEG, China National Oil & Gas Exploration & Development Corp. has issued a contract to a group led by China International Water & Electric Corp. to build a 148 mile gas line from Gabes to Msaken. Gaz de France is also involved.

Construction of the 82 mile 20 in. and 66 mile 24in. lines (including 4 mile link with the Tunis grid) is scheduled for completion in early 1995.

Inter country/regional trade flows

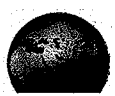




Major pipelines and LNG terminal

EXPORTERS		TRAINS
A	Das Island, Abu Dhabi	2†

† 3 from May 1994

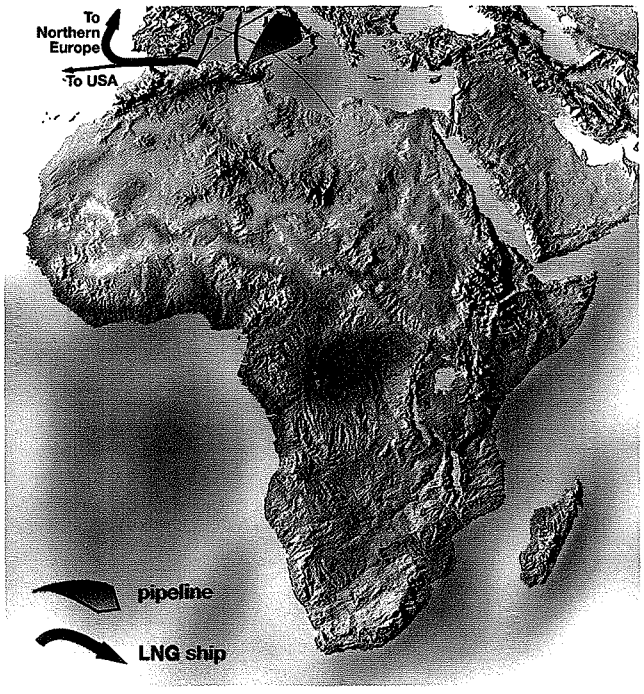


Imports by pipeline 1993

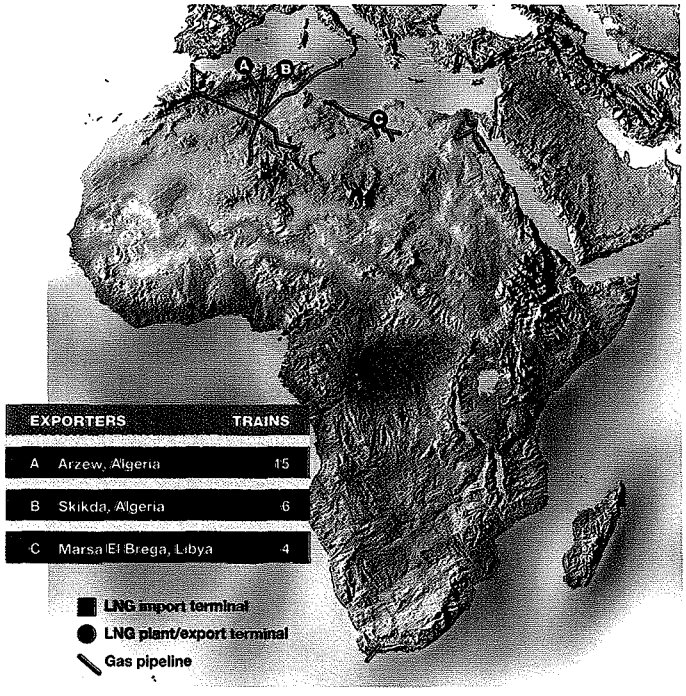
(bcm)

EXPORTER													IMPORTER
USA	Canada	Bolivia	Mexico	Denmark	Germany	N'lands	Norway	UK	FSU	Iran	Algeria	Malaysia	Total Imports
											0.55		Tunisia 0.55
											0.55		

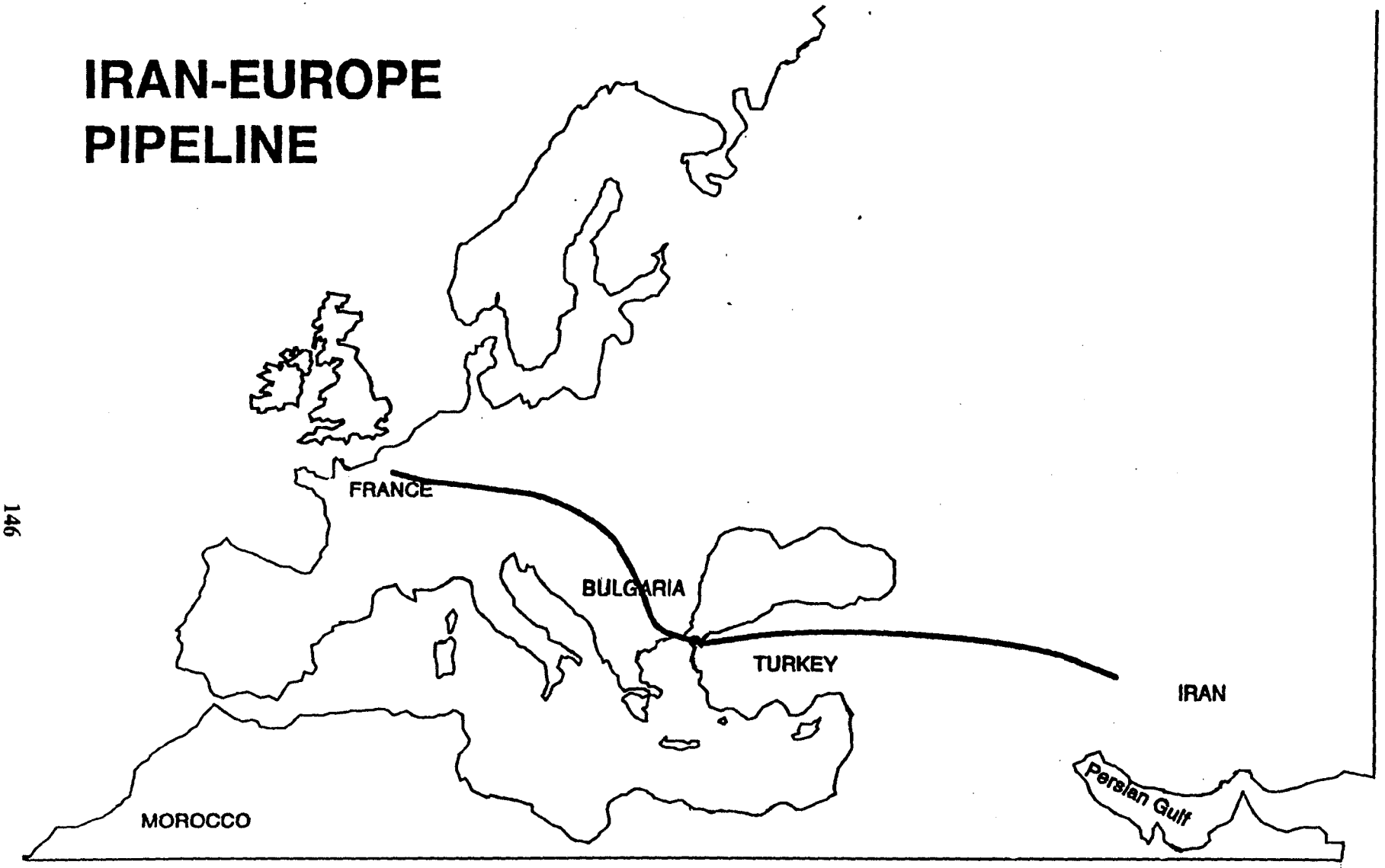
Inter country/regional trade flows

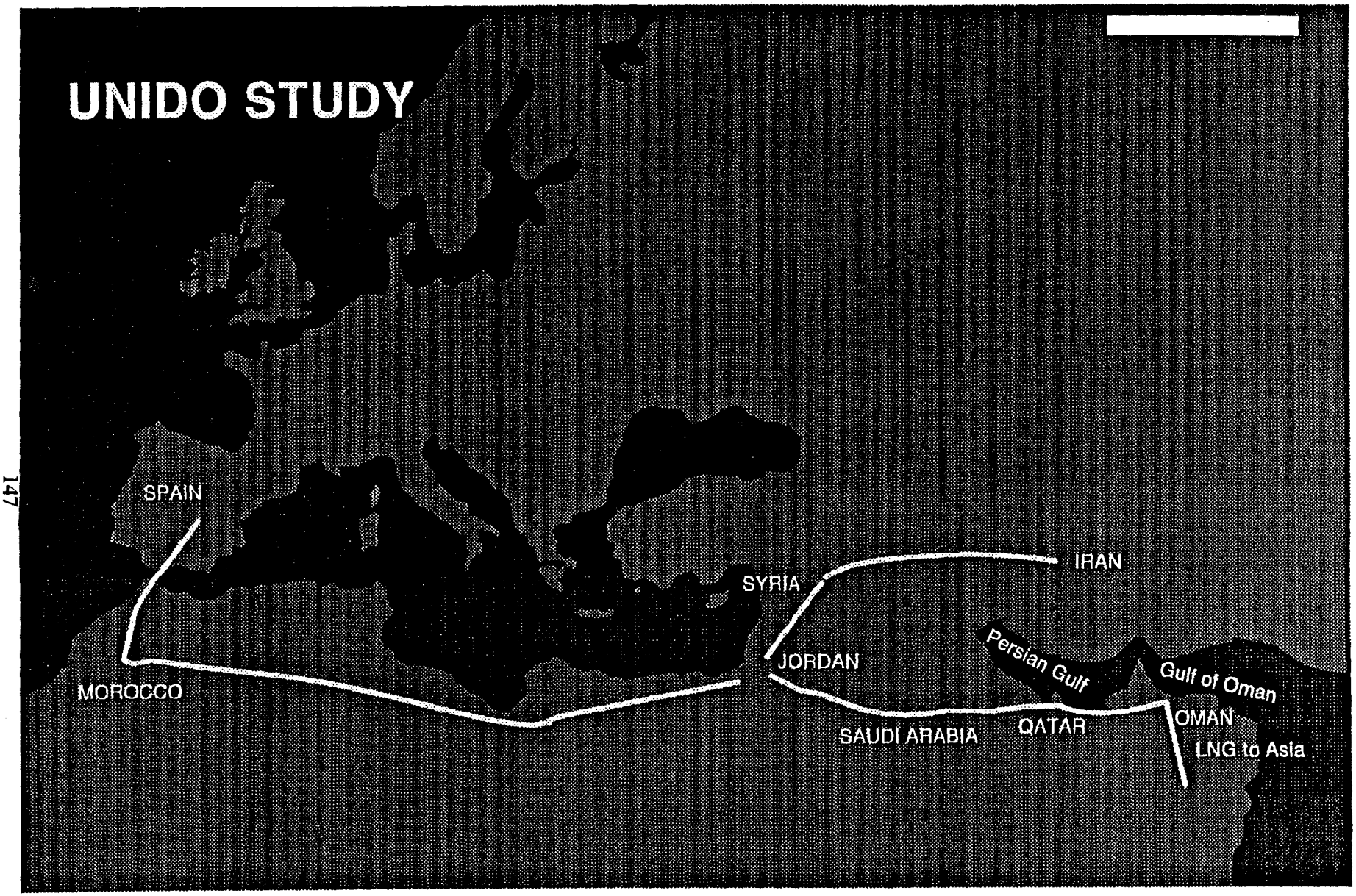


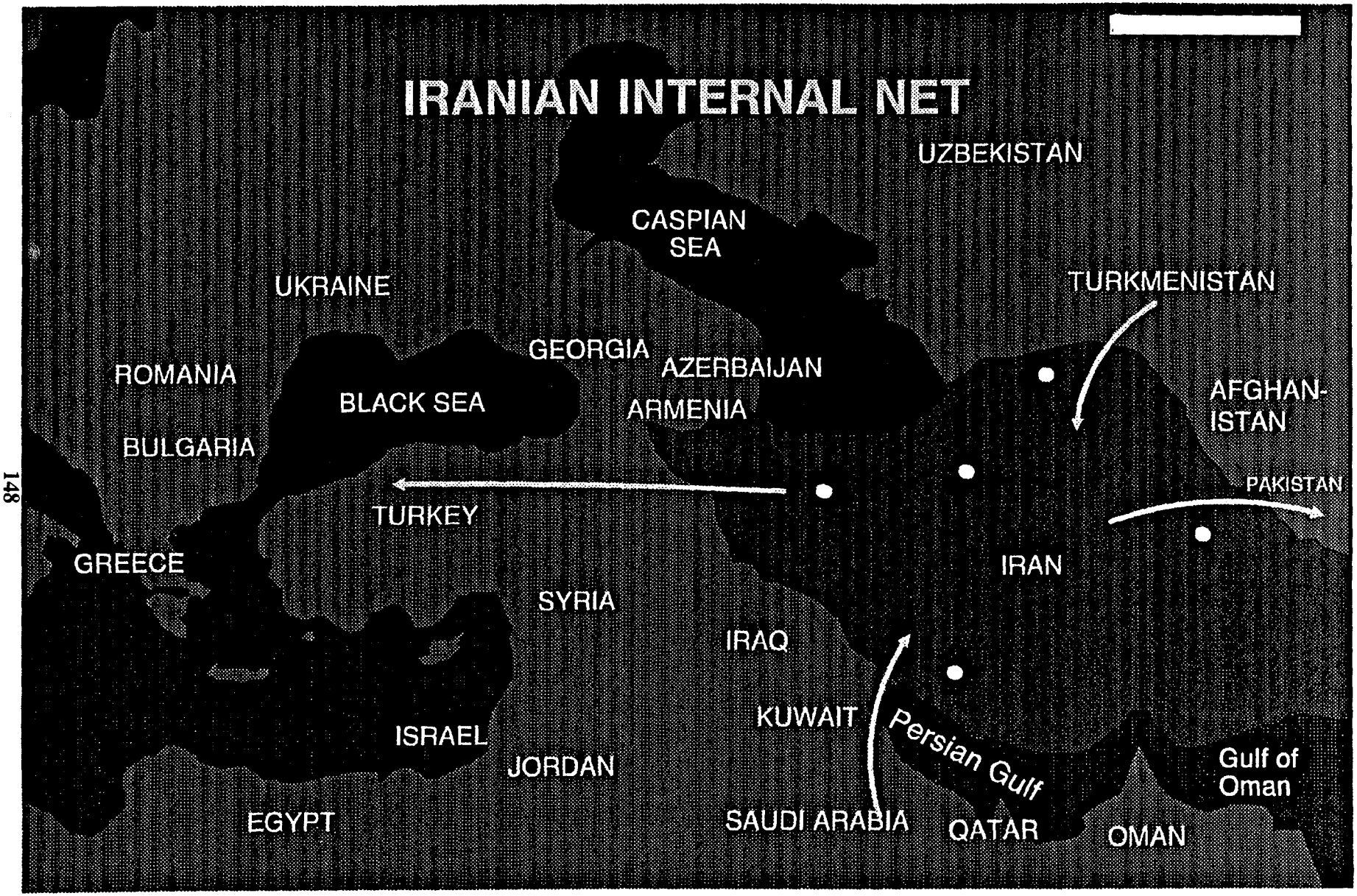
Major pipelines and LNG terminals



IRAN-EUROPE PIPELINE




UNIDO STUDY
SPAIN
MOROCCO
SYRIA
JORDAN
IRAN
Persian Gulf
Gulf of Oman
OMAN
SAUDI ARABIA
QATAR
LNG to Asia


IRANIAN INTERNAL NET
UZBEKISTAN
CASPIAN SEA
UKRAINE
TURKMENISTAN
GEORGIA
AZERBAIJAN
ROMANIA
BLACK SEA
ARMENIA
AFGHAN-ISTAN
BULGARIA
PAKISTAN
TURKEY
GREECE
IRAN
SYRIA
IRAQ
KUWAIT
Persian Gulf
ISRAEL
JORDAN
Gulf of Oman
EGYPT
SAUDI ARABIA
QATAR
OMAN

Algeria

In the 1994 International Gas Pipeline Expansion Study (page 4) reference was made to political unrest in the country which might affect Europe's links to Algerian gas. This note explores the matter in greater detail.

The West - and Europe in particular - has a vital interest in stability in Algeria. Every year the country exports 576 billion cubic feet (bcf) of gas, mostly to Southern Europe, making Algeria the third largest supplier of gas to the European Union behind Norway and Russia. The stability of this supply has been put at risk by this latest political crisis which has seen Algeria controlled by force of arms. Although, despite the chaotic situation, no western company has yet totally closed down its Algerian operations nevertheless many have reduced expatriate staff and the US government returned many diplomats to Washington early in the year. State-owned Sonatrach has remained intact.

Economic difficulties are endemic. A hard currency shortage and a dangerously high budget deficit mean investment funds will have to come from overseas. Hindering solution of the economic problem is the interest repayments on the country's $26 billion foreign debt coupled with the fall in the world oil price. Ninety-five percent of Algeria's income is derived from hydrocarbons; the country loses $500 million for every $1 fall in the world price for crude. Hopes are pinned on a deal with the IMF to loosen the noose of debt repayments while giving Algeria extended credit backing and international political support. In return the IMF insists on substantial devaluation and reform of the country's cumbersome nationalised industries. However, the government is wary of exacerbating current social unrest by meeting these demands.

Western companies await resolution of Algeria's political crisis. At mid-year the long term prospects for stability do not look good. Undoubtedly the crisis comes at a bad time for the oil and gas industries which had been planning considerable expansion aimed at doubling exports of natural gas from 1.26 tcf in 1992 to 2.34-2.52 tcf by the year 2000. Included in the programme are development of 11 gas fields already discovered south-east of Hassi R'Mel and of the Salah fields in the Reggan basin in the south which BP considers to contain significant gas reserves. In this desert area BP has drawn up plans to build a 300 mile pipeline from the site to join the existing pipeline network at Hassi R'Mel to connect to Eurogas markets through the Magreb and TransMed pipelines. In return BP is carrying out commercial studies of the European energy market to assess potential areas of interest to Sonatrach. The political condition must cast some uncertainty over these arrangements.

Historically it has to be admitted that the quality of crude and natural gas supplies and proximity to the European markets made Algeria an attractive exploration area, particularly when foreign companies were allowed back as partners with Sonatrach in production sharing contracts. Exploration activity increased markedly following the passage of the Petroleum Law in 1986 and modifications to it in 1991 and 1992. These partnership opportunities extend to service companies: an Algerian private company and French FORASOL formed a joint venture called FORASUD as did, similarly, Algerian drilling contractor ENTP and Dentag of Germany.

Discoveries have been made by AGIP, Anadarko, BHP, Cepsa and Repsol. Foreign partners have been instrumental in introducing new technologies such as 3D seismic and horizontal drilling.

Final remarks centre on gas developments. While the political climate deteriorates, work is still going ahead on the giant gas export pipeline from the gas fields as Hassi R'Mel via Morocco to Spain and Portugal. This is the Maghreb pipeline, scheduled to come into operation at the end of 1996. Construction work on the 330 mile Algerian section has already been started by Bechtel, while engineers from JP Kenny and INTECSA of Spain are investigating the best route to cross the Straits of Gibraltar and the construction problems the contractor is likely to meet - water depths of up to 1300 feet, strong bi-directional currents, a stripped seabed and the possibility of minor earthquakes and tremors. This pipeline will have a capacity of 288 billion cubic feet a year.

By 1996 Algeria will have gas export sales lined up totalling 2.0 tcf - and hopefully up to 2.16 tcf by the year 2000. As a result, the liquefaction units at Arzew and Skikda are being expanded. By 1996 their combined capacity will be 1.08 tcf a year.

At the same time the capacity of the existing 1,300 mile TransMediterranean gas pipeline from Hassi R'Mel through Tunisia and Sicily to Italy is being expanded from 576 bcf to 864 bcf a year.

These are ambitious plans. It is difficult to see how the present political unrest will not affect them. However, it is equally difficult to see how even fundamentalists will cause longterm harm to the hydrocarbons sector upon which the future security and progress of the economy depends.

Chile

The 1994 International Gas Pipeline Expansion Study, in its Overview (page 2) and South America (pages 59-66) section, drew attention to the rich potential for foreign investment in pipeline development being promoted on a bilateral basis. This note describes the situation in Chile (enhanced by cooperation with Argentina) which may well see 1994 as its most important year in energy history since the discovery of oil in 1950. The return to democracy - for both countries - provides the backcloth for this exciting set of events.

Although oil was found nearly 45 years ago, volumes have never been high. With the populated areas separated from the oil fields by over 1000 miles of mountains onshore and some of the world's roughest seas offshore, transport has always been a costly problem. However, 250 miles of mountain pipeline is changing the picture with start up in February 1994 of the (initially) 38,000 b/d new trans-Andean oil pipeline. Although oil production has been disappointing with new finds welcome the trend toward gas has been clear for some years, albeit as part of a fuels diversification strategy.

Ten years ago there was an embryo plan to pipe indigenous gas from the Magellan Strait but the intervening 1000 miles of mountain and desert - even before the fringes of population were reached - made that a nonstarter. More attractive alternatives were to import gas from Bolivia or Argentina. Bolivia was ruled out on both geographical grounds and its claims on Chile's

northern provinces. Also, at this time, relations with Argentina were strained over border disputes in the far south.

Happily, the return of democracy in Chile and in Argentina has led to the quiet burial of age-old disputes. Now, after a rocky start, the two have become good trading partners, each having something to offer the other. The oil pipeline is the first fixed emblem of that. Now both sides are actively pursuing plans for a gasline, to run 750 miles from Argentina's Neuquen fields right through to Santiago. The project was first considered seriously about five years ago but it was not until Argentina's oil and gas industry was finally brought fully into the private sector that plans could mature, given that project finance of around $1.65 billion will have to be found, a sum that would only have exacerbated the debt situation of the old state firms.

The project falls into three main sections. First, the transmission line from Neuquen. Tenneco Gas has been named technical operator for this, currently costed at $600 million. It would move 288 mcfd of gas, with the main line running to Santiago. Branches to at least six other cities, notably Valparaiso and Concepcion, would follow. The second section involves the various distribution systems, for which British Gas has been chosen as technical operator. This is costed at $450 million and would serve 600,000 premises. But total investment is not needed at once, British Gas seeing the total cost of sections one and two being spread over 25 years. Clearly, the aim is to tackle one conurbation at a time, a job British Gas sees taking 10-15 years after initial gas flows. But the bulk of transmission-line costs will have to be up front, apart from whatver is needed for branch lines. And that poses the main problem.

To justify the transmission-line investment, the various partners in the scheme has to show that it is viable (more or less) from the start. No financier is going to wait 10-15 years while Chilean households are connected one by one. To provide an immediate base load for the transmission line, the partners have proposed section three: the construction of three gas-fired power stations rated at 700 MW in all and costing $600 million. These would take 45 percent of the pipeline's throughput. Another scheme, under which an early secure market would be nailed down, is for 5 percent of capacity to go as CNG fuel for buses in Santiago. Pollution there is said to be worse than anywhere else in Latin America, except Mexico City. Legislation on such matters is long out of date and, as soon as new rules are promulgated, a major switch to less polluting fuels is certain. But gas cannot be used unless it is available.

This chicken-and-egg situation urgently needs to be sorted out. Partners on the Chilean side have already formed Distribuidora Gas De Chile, currently owned by Enap, state electricity utility Chilectra Metropolitana and overseas interests represented by Snam, Italgas, Enagas and Catalana de Gas. A supply deal has been signed with an Argentine group comprising YPF, Astra, Bridas, Pluspetrol and Petrolera San Jorge (operating as Union Transitoria de Empresas). As already mentioned, technical operators have been appointed. But there is still discussion about how much equity should go to international firms. As long as this remains unsolved, financing the project cannot begin seriously. Even so, the various partners are optimistic that construction could begin towards the end of 1994. Santiago would get its first gas late in 1997, though British Gas believes that a 1996 start-up date is possible.

Initially, the Argentine government did not want ex-state oil firm YPF to get involved other than as a supplier. Now however, YPF is negotiating for a 10 per cent stake in the transmission company, Transporte Gasoducto Transandino, at present owned by Chilectra and its partners. Currently British Gas and Tenneco are conducting studies into the project, for

completion by end 1994. The aim then is to build up a wide mix of equity partners so that the system will not run at the whim of one major player.

In this, the full scale privatisation in Argentina will help. Now Chile is going down the same route, albeit more slowly. The existing oil line includes private sector interests. The gas system will follow suit. Outisde interests also now have a role to play in refining, while further downstream the private sector is dominant. Upsteam, international companies have long played a part and continue to do so. Also indicative of the market-led pragmatism that is sweeping South America is the agreement reached at the start of 1993 for Chile and Bolivia to rehabilitate the 1956-built oil pipeline that links Arica on the Chilean coast to Siccha in Bolivia. This is being revamped to carry light products inland, with a reversible flow moving Bolivian crude and heavy fuels to the coast for export. That, too, could ease Chile's oil supply costs and aid diversification. And international relations in the region have probably never been better. That in turn is attracting much-needed international investment in the industry.

An intriguing feature has been added to the Chilean gas pipeline scenario by the entry into the play of Nova Corporation with its Gas Andes project. In Autumn 1994 the company confirmed that it was wishing to build on its already established position in north Argentina - where it has purchased an operating interest in the northern leg of the main Argentine pipeline as part of the line's $2 billion privatisation - by tendering a scheme to cross the Andes in competition with the Tenneco - British Gas proposal.

India

This note recognises that these are critical times for India's energy planners. Domestic crude output remains short of demand (as does refining capacity) and gas and electricity shortages blight industry and cause blackouts. The emphasis here is on gas plans, describing in greater detail, and setting in the current economic context, the matter set out on page 19 of the 1994 International Gas Pipeline Expansion Study.

India's need for more energy must be set against a budget deficit in 1993-4 likely to approach $45 billion, a steadily rising population of just over 860 million and a fast-declining hydrocarbons reserves base. In 1992 the Planning Commission estimated that domestic oil and gas would last less then 25 years at the present consumption level. Draftingh tei Egtth Five-Year Plan (1992-1997), the Commission warned that an uncontrolled growth in demand for petroleum products would make the balance of payments position unmanageable. It called for strict monitoring of demand during the Plan period and beyond. Whereas product use in 1990-91 was 55 million tons, then 57 million in 1991-92, the Commission foresaw 81 million for 1996-97 and a daunting 125 million for 2006-07. Oil production was forecast to go up to 50 million tons/year by 1996-97 - the achieved figure was 28.7 million tons in 1992 - if development plans by government proceeded on schedule.

The Commission recommended expansion of existing refineries and adoption of conservation measures, demand management and substitution development. Natural gas could be used in fertilisers, petrochemicals, power generation and for extraction of LPG for use as a household fuel.

Having largely spurned the foreign private sector for years, India is now turning to it increasingly to try to alleviate its problems, with a more liberal attitude to licensing and imports. Big imports of gas in several forms have exciting potential in the sub-continent, which promises enormous investment opportunities for the astute in the coming decade.

The economic reforms taking place in India have demonstrated the move away from the bureaucratic, "pink" economy, hobbled by high inflation, massive tax evasion and a balance-of-payment crisis, to the market oriented liberal system recommended by the advocates of radical transition: the government relaxed restrictions on foreign ownership of companies, granting automatic approval for 51 percent ownership in 36 sectors, and allowing 100 percent ownership on a case-by-case basis. Capital gains tax for foreign investors was reduced to 10 percent below what domestic companies pay. The rupee was made fully convertible on trade accounts, and Indians were allowed more latitude to use foreign exchange for business purposes.

The results? In a country where the annual per capital income is a mere $310 and at least 300 million people live in poverty, almost a million hold credit cards, and according to Visa International 40 million Indians have incomes of more than £30,000. More goods are available, often cheaper and of higher quality than in the past, but the pattern of many people's lives is threatened by unaccustomed economic uncertainty. No wonder that India, like Mexico, is periodically the scene of violent riots where religious, ethnic and class tensions surface.

Commentators of the international business scene have evidenced India's new thinking on oil and gas by reference primarily to the more realistic approach to exploration. It is recognised that five-year plan targets for hydrocarbons could not be achieved by state firms ONGC and OIL by themselves: therefore, large areas of the offshore have been offered to foreign searchers. Of especial interest has been deepwater areas in the prolific Bombay High.

In the Bombay High area a huge programme to cut gas flaring is underway. This and gas from reservoirs elsewhere could play a vital role in reducing oil dependence. Like other developing countries, such as Indonesia and Egypt, India is realising that gas has enormous power generation, industrial and domestic potential. According to official sources India needs around 9.20 bcfd of gas but domestic availability is only 1.75 bcfd, and by 1996 it will rise to a mere 2.3 bcfd. Once more gas can be provided it is envisaged that demand will soar as much as 15 times over what can be supplied.

An important source of domestic gas is the South Bassein field off the west coast, from which a second trunkline to Hazira onshore treatment plant is now to be laid. The 155 mile, 42-inch artery will essentially parallel the existing line. Permission for the second was granted in 1992 by the Public Investment Board, which also agreed a 87 mile line to link the ICP platform in the Bombay High oilfield area to Hazira. Some funding is coming from ADB, some from the World Bank, more from Japan's Exim Bank and ONGC funds. John Brown Engineering won a contract from Samsung Heavy Industries, of South Korea, for detailed engineering and procurement assistance for the $70 million BE wellhead platform in South Bassein to boost gas throughput by about 175 mcfd. The project includes a four-leg jacket, pipelines and modifications to existing platforms. An earlier contract, to supply line pipe for the South Bassein-Hazira trunkline, was granted to Saw Pipes of India, ILVA of Italy and Europipe of Germany. Capacity of the Hazira terminal will also be raised from 705 mcfd to 1.45 bcfd by 1995-96, another essential component of the government's zero-flaring gas aim.

Hazira is the western terminal of the 750 miles Hazira-Bijaipur-Jagdishpur (HBJ) overland trunkline which went on stream to serve industry in 1987. About 18 months ago the Gas Authority of India (GAIL) requested a technical assistance grant from ADB to boost HBJ's capacity from around 650 mcfd to 1.15 bcfd. More ambitious gas line plans have been considered for the sub-continent. Although in 1992 an expert committee determined that a gas grid to serve southern India was not viable - it would cost $750 million to move the 350 mcfd of gas required, and gas was not immediately available - Petroleum Ministry sources have lately indicated that such a grid might be finished within a few years. As long ago as the mid-1980s a national gas grid was proposed which could cost $6 billion.

An important move towards the gasifying of urban India was the setting up early in 1993 of a joint company by British Gas and GAIL to supply natural gas to Bombay, with the government of Maharashtra as a shareholder. Over the next decade $150 million will be invested towards a distribution network to serve more than 600,000 commercial, domestic and industrial users in the Bombay area, drawing on western waters gas. GAIL has since been asked by the Petroleum Ministry to consider a piped supply to 250,000 households in New Delhi, taking gas from the HBJ line.

Imports could transform India's gas scene. Early in 1993 New Delhi lifted government's monopoly on LPG, permitting the private sector to import bottle and market it. The authorities in mid 1992 agreed that private and foreign firms could set up refineries to make LPG among other products, Liberalisation has led to a spate of developments. Already IOC had decided to establish a new LPG terminal at Kandla port in Gujarat to handle 600,000 tons a year. Since then IBP has announced it will enter the business, estimating that about 800,000 tons a year more LPG than was imported by government was needed to meet the waiting list for it, put at nine million. Parmar LPG Bottling said it would import 1 million tons a year, with a port to be developed at Pinjarat, near Surat in Gujarat. Hindustan Petroleum has been given permission for facilities at Mangalore port in the south to handle 600,000 tons a year. A new jetty has been proposed, too for Visakhapatnam port, capacity 450,000 tons a year, on the eastern coast. This is one of two ports, the other being Bombay, able to import LPG but both near saturation point. In addition, the Shri Shakti LPG group plans facilities at Kakinada port in Andhra Pradesh to eventually handle 100,000 tons a year.

Officially it is hoped that indigenous LPG output will rise from about 2.30 million tons in 1992 to almost 3 million in 1994-95. Imports in 1992 were restricted to 500,000 tons.

LPG imports are in mind for electricity generation. Blackouts plague India, which has installed capacity of 72,000 MW, planned to be raised to 100,000 by 1997, but even that will be up to 20 percent short of needs. Almost 50 new coal, gas and hydro-electric projects are being discussed, but the 25,000 MW involved will cost $25 billion. Hope stems from the spate of private proposals such as US firm Enron Power's projected 1,905-MW, LNG fuelled power station at Dhabol, in Maharashtra state, a first phase due on stream in 1996. Eventually it will use LNG imported from Qatar.

India is also hoping for piped gas imports. Several trunkline options are in mind, with Iran, Qatar, Oman and even offshore Yemen being tipped as possible sources. They may eventually spawn two trunklines. A pipeline from Central Asia to Karachi for transhipment is said to make sense for Turkmenistan, Uzkebistan and Ukraine, reducing dependence on Russia by

being routed through northern Iran and Pakistan. Supply availability, price and technical and economic aspects and political factors have all to be considered.

The Middle East

Reference was made in the 1994 International Gas Pipeline Expansion Study (page 3) to the need for improved political clarity so that prospective new gas supply projects might be moved forward. This note explores the ideas for energy transfers and projects between Israel and its Arab neighbours which are associated with the prospect of general peace in the Middle East. Essentially, it develops in more detail the matters outlined in the above mentioned Expansion Study (pages 114 and 115).

Israel and Qatar have been holding a series of discussions on the long-term possibility of Qatari gas exports to Israel and thence, perhaps, to Europe. Egypt and Israel are also discussing a gas pipeline from Egypt to both Israel and Palestine.

In the immediate future, the most probable energy project resulting from improved political prospects in the Middle East concerns Egyptian gas deliveries to Israel and the Gaza Strip. the Egyptian project can be undertaken at an early date because Egypt already has full diplomatic relations with Israel and because, by providing gas to the energy-starved Gaza Strip and possibly to the West Bank as well, the project would also help the Israeli-Palestinian peace process.

For both political and commercial reasons, the Egyptian gas export project may make good progress. Egypt's key role in the Middle East peace process - a role which is underestimated in the West - means that the Egyptian government has much to lose should the Israel-PLO deal collapse. But to secure widespread Palestinian support for highly controversial accord with Israel that lays down a timetable for peace but which does not tackle either the physical or political limits of any prospective Palestinian entity, will require rapid progress on the economic front. And, that means, inter alia, the rapid provision of new energy supplies for Palestinian territories which have been starved of energy for both industry and domestic consumption.

Egypt's prime commercial concern is how to make the best of a limited resources base. It is understood that Egypt would need to possess some 26 trillion cubic feet (tcf) of reserves by year 2010 in order to meet its anticipated domestic demand.

Although Egypt does not currently possess such reserves, it is engaged in what appears to be a highly successful effort to discover fresh reserves. In the late 1980s, the reserve base rose relatively slowly, increasing by 20 percent between 1986 and 1990, when it reached 11.7 tcf. Since then, it has increased at a much faster rate. In 1992 it climbed to 12.9 tcf and at the start of 1994 the government announced that the country's estimated reserves totalled no less than 21 tcf.

With Egyptian planners determined to encourage domestic gas consumption, thus freeing up oil for export, the key questions to be answered concern the extent of the surplus Egypt now enjoys, the length of time the surplus can be expected to last, and Egypt's capacity to ensure production outstrips domestic consumption.

Recent reports indicate that Israel is discussing imports of some two million tonnes per year. This is equivalent to around 210 million cubic feet per day and, over a 15 year period, would entail the delivery of a total of 1.15 tcf. Egypt would need a 200-300 million cubic feet per day production surplus if it was to export gas to Israel. Egypt's own aggregate demand for the period 1993-2010 is estimated at 22.4 tcf, so, allowing for some leeway, the country does indeed require a reserve base of close to 26 tcf if it is to become even a modest exporter.

Perhaps the most important aspect of 1993 was mention of a gas line to Gaza and possibly Israel, placing the initial emphasis on he Palestinian territory. In 1994 almost all of the focus has been on a line to Israel. But Gaza is enroute to Israel from Egypt, it lacks the indigenous energy, it is desperate for foreign assistance - and its development from urban refugee slum to commercial entrepot is considered crucial to the long-term success of the peace process.

For these fundamental reasons, coupled with Egypt's role as the principal Arab facilitator for Israeli-PLO negotiations, it is impossible to envisage any Egyptian gas deal with Israel excluding a link to Gaza. And given the energy shortage on the West Bank, if commercial funding can be made available then almost certainly any pipeline to Israel would be extended to serve West Bank Palestinians as well.

The question of Egyptian gas supplies to the north was discussed in talks held between Italy and the PLO in early 1994. Italy is interested because one of the principal gas producers in Egypt is a joint venture between the Egyptian General Petroleum Company and Italy's state-owned AGIP. One relevant factor is that AGIP has so far been selling its equity production to the Egyptian authorities to help them keep up with soaring domestic consumption, which for the last five years has kept pace with increased output. But if output can start to grow faster than domestic consumption, AGIP would be free to take its equity share in joint 3.3 mtpy output from the Abu Madi field, and subsequent output from its recent discoveries elsewhere in the northern Delta and offshore, and pipe it up to customers towards the north.

Israel economists at the University of Tel Aviv have estimated that it would cost between $70 million and $170 million, depending on size, to construct a gas line to Israel's Mediterranean coast. Israeli's Merhav group in late 1993 expressed an interest in constructing such a pipeline.

There is still considerable confusion about Israel's contacts with Qatar concerning possible deliveries of Qatari gas. The first of these contacts preceded the relevation in August 1993 that Israel and the PLO were engaged in direct talks. The Qatari Foreign Minister has met twice with his Israeli opposite number to discuss natural gas deliveries. But the official Qatar news agency quoted him as saying in January that "We have made it clear to Israel there will be no progress in our ties before there is a big progress in the peace process and especially on the Syria and Lebanese tracks".

In Autumn 1993 the Israeli Energy Minister said Israel expected to sign a 25 year gas supply deal with a Gulf emirate within two weeks. Amidst strong speculation that he was referring to Qatar, Qatari sources issued an immediate response saying that "regarding rumours quoting Israeli that an agreement will be concluded in the coming weeks between a Gulf state, which could be Qatar, and Israel for a project to construct a gas pipeline to Israel." HE Abdullah Hamad al-Attiyah, the Minister of Energy and Industry of Qatar, categorically denied the validity of these rumours, which he regarded as "unrealistic and devoid of any logical basis."

The statement added "Any proposal along these lines has no factual basis as long as the Arab League Council does not take a decision rescinding its earlier decision on the Arab boycott of Israel."

In effect, what seems to be happening is that Israel, which is in the middle of drawing up plans for increased reliance on natural gas, is pressurising Qatar to conclude an agreement in the near future while Qatar, which does not want to break ranks with mainstream Arab countries, is only prepared to say it is ready to consider an agreement in principle, but not to implement any physical project until it is clear that there will definitely be a comprehensive Middle East peace, including Syria, and not just a bilateral Israeli-PLO accord.

Despite various comments and reports indicating a possible pipeline from Qatar to Israel (perhaps a land line via Iraq and Jordan) it is now clear that what is being discussed in LNG shipments to the Israeli port of Eilat.

Israel is reported to be willing to pay a significant premium to secure gas deliveries, with import costs estimated as high as $4.0 per million BTU. This compares with a recent calculation that Qatari LNG deliveries to Italy would be around $2.55 per million BTU. Israeli accounts have also spoken of connecting Israeli internal distribution of Qatari gas with existing European gas networks, This appears highly unlikely in view of construction costs for pipeline connections or the need for fresh facilities for outward LNG shipment across the Mediterranean

It may, however, be worth speculating a little on where the Israeli Qatari discussions might fit in with general Middle East energy arrangements in the medium and long term. The LNG proposal has the advantage of being an essentially bilateral arrangement. But in the event of a comprehensive settlement, then pipeline options embracing other countries will become viable. The suggestion of a route through Iraq - presumably a post Saddam Iraq - would open the way for the provision of Qatari gas not only to Israel but to Kuwait (a former customer of Iraqi gas), Jordan and the Palestinian territories. There would also be options for connections to the Turkish gas grid which is already part of the European system.

The most likely prospect is that 1995 will see Israel trying to pin Qatar down to a firm specific arrangement, while Qatar examines a variety of options which may or may not end up embracing Israel.

Israeli reports have also suggested Iranian interest in reviving the Eilat-Ashkelon oil pipeline through which oil supplies from Imperial Iran used to reach Israel's cities. The government of what is now the Islamic Republic of Iran is still a co-owner of the pipeline and Israel is known to be interested in seeking its reactivation to serve not only Israel but other Mediterranean customers, so that the line would become a competitor to Egypt's Sumed system.

But if Israel is looking to a possible revival of its oil relationship with Iran then neighbouring Jordan is likewise looking to a strengthening of its oil relationship with Iraq. In January, when the two countries renewed their agreement on soft-term Iraqi oil deliveries to Jordan the two countries also agreed to reconsider the often-mooted project of an oil pipeline from Iraq to the Jordanian port of Aqaba. Jordanian Oil Minister Walid Asfur said such a project would not be implemented until after UN sanctions against Iraq were lifted and that it would include the construction of a refinery at Aqaba to service both local export markets.

Such a pipeline was seriously envisaged between 1983 and 1985, when Iraq, then at war with Iran, sought assurances from Israel that the line would not be subject to Israeli attack. although top officials in the Bush administration worked to secure such assurances and also US export finance for the project, in the end Baghdad felt the security guarantees on offer were insufficient to meet is requirements and it opted instead for further expansion of the IPSA system through Saudi Arabia to Yanbu. Iraq's renewed interest in the project has almost certainly been triggered by its nervousness concerning its relations with its other neighbours. Pipeline outlets through Turkey and Saudi Arabia, closed at the outset of the Kuwait crisis in 1990, are still shut. The pipeline to the Syrian port of Banias and the Lebanese refinery at Tripoli has been closed since 1982. Baghdad itself took the decision to close the much older pipeline through Jordan to Halfa when the State of Israel was proclaimed in 1948.

Alphabetical Listing by Country of

MAJOR GAS PIPELINE CONSTRUCTION WORK WORLDWIDE

ABU DHABI

ABU DHABI OIL CO. 113 miles, 42 in. and 36 in. gas line from Bab to Taweelah by way of Maqta. Completion: 1995.

66 miles, 16 in. gas line from Habshan to Ruwais. Completion: 1995.

78 miles, 36 in. gas line from Habshan to Ruwais. Completion: 1995.

25 miles, 18 in. gas line from Bab to Mifta. Completion: 1996.

155 miles gas lines as part of onshore gas facility at Habshan. Contractor: Bechtel.

ALGERIA

SONATRACH. 330 miles, 48 in. leg of the Maghreb-Europe gas line between Hassi R'Mel and Berguent on the Moroccan border. Completion: 1995. Contractor: Bechtel.

90 miles, 8-14 in. gas line from Rhourda Chouff and Rhourda Hamra gas field. Completion: 1994. Contractor: Snamprogetti.

400 miles, 42 in. gas line from Hassi R'Mel to Skikda. Completion: 1995. Contractor: Spie-Capag.

621 miles, 10-24 in. LPG line connecting the Alrar West field with the main processing plant at Hassi R'Mel. Contractor: Entrepose. Engineering: Sofregaz.

SONELGAZ. 300 miles gas line from Hassi R'Mel to the Moroccan border proposed.

ARGENTINA

336 miles gas export line from San Jeronimo field to Brazilian states of Parana, Rio Grande de Sol and Santa Catarina under study.

2,020 miles gas export line from the Campo Daran fields to Uruguay and Paraguay under study.

AUSTRALIA

GOLDFIELDS GAS TRANSMISSION. 980 miles gas line from Karratha, near Port Hedland, through the Eastern Goldfields to Kalgoorli. Sponsored by the Western Australia government. Completion: second half 1996.

WESTERN AUSTRALIA PETROLEUM CO. 80 miles gas line from the Gorgon field to the Karratha Woodside LNG facility planned.

WOODSIDE PETROLEUM DEVELOPMENT. 22 miles, 30 in. gas line from the North Rankin field and 118 miles, 10-14 in. lateral from Dampier to Pibras planned.

PIPELINE AUTHORITY OF SOUTH AUSTRALIA. 144 miles, 4 in. gas line from Angaston to Berri with a lateral to Murray Bridge. Completion: 1995. Contractor: McConnell Dowell.

800 miles, 14 in. gas line from Palm Valley to South Australia under consideration. Completion: 1998.

750 miles, 14 in. gas line from Northwest Territory to South Australia under consideration.

200 miles, 4in. (or 6 in.) gas line in Roxby Downs area.

375 miles, 12 in. gas line in the Minerva area.

QUEENSLAND GOVERNMENT. 500 miles gas line from Southwest Queensland fields to Roma (and Brisbane) planned. Completion: 1996. Contractor: Santos Ltd.

124 miles gas line from Cooper and Eromanga Basins to Moomba in South Australia.

100 miles gas line from Denison Trough to Roma under consideration by Oil Co. of Australia.

PIPELINE AUTHORITY OF CANBERRA. 870 miles, 8 in. ethane line from Moomba to Sydney. Completion: 1996. Contractor: East Australian Pipeline Ltd.

82 miles, 12 in. gas line from Albury to Wagga Wagga to Junee under study by East Australia Pipeline Ltd.

NORTHERN TERRITORY POWER AND WATER AUTHORITY. 205 miles gas line from Daly Waters to power station for McArthur River zinc-lead mine near Borroloola. Contractor: McMahon Holdings Ltd.

375 miles gas line from Darwin to Gove in planning stage by Magellan Petroleum Australia Ltd. Contractor: Nabalco pty. Ltd.

367 miles, 12 in. gas line from Mataranka to Gove under study.

ESSO EXPRO AUSTRALIA AND BHP PETROLEUM. Dual 29 miles gas lines from Bass Strait fields to Longford, Victoria planned.

ELF AQUITAINE. 183 miles gas line from offshore Tern and Petrel fields to onshore at Bonaporte and on to Darwin under development.

SANTOS LTD. 70 miles 4-14 in. gas gathering system at Cooper Basin planned.

AUSTRIA

ROHOL-AUFSUCHUNGS AG. 44 miles gas line from Burghausen (in Germany) to Puchkirchen in Upper Austria planned.

BANGLADESH

TITAS GAS TRANSMISSION AND DISTRIBUTION CO. 27 miles, 12 in. gas line from Elenga to Tarakandi planned.

35 miles, 24 in. gas line from Dhania to Mymensingh planned.

77 miles, 24 in. gas line from Elenga to Ashunganj planned.

PETROBANGLA. 35 miles, 30 in. gas line from Ashunganj to Bakhrabad. Completion: July 1996

BELGIUM (and Luxembourg)

DISTRIGAZ. 20 miles, 12-20 in. gas line from Lichtervelde to Niewpoort. Completion: December 1994.

4 miles, 10 in. gas line in Gent. Completion: December 1994.

6 miles, 22-30 in. gas line from Loenhout to Rijkevorsel. Completion: December 1994.

4 miles, 10 in. gas line from St. Gillis Waas to St. Niklaas planned.

4 miles, 10 in. gas line from Willebroeck to Boon planned.

63 miles, 16 in. gas line from Dalhem to Bastogne planned.

60 miles gas line from Berneau to Bastogne awaiting authorisation to begin construction.

BOLIVIA

YACIMIENTOS PETROLIFEROS FISCALES BOLIVIANOS. Natural gas line from Santa Cruz de la Sierra to Porto Suarez, connecting at Mato Grosso do Sul, Brazil.

Trunk gas line to Paraguay under consideration. Completion: 1997.

680 miles gas line from southern Bolivia to northern Chile for power generation use. (Joint venture with BHP and ENAP).

MENDES JUNIOR. 132 mile gas line from Yapani to Colpa y Ramal which will act as feeder line to Bolivia-Brazil trunkline under construction.

BRAZIL

PETROLEOS BRASILEIRO SA (PETROBRAS). 2000 miles gas lines from Santa Cruz, Bolivia to Sao Paulo, Brazil (965 miles, 14 and 28 in.) dividing into trunk line near Campinas south to Porto Alegre and spur to existing Rio de Janeiro-Sao Paulo line to Belo Horizonte (735 miles 14-22 in.). Completion: 1997.

60 miles, 8 in. gas line from Macae to Cantagalo to supply cement and paper works. Completion: end 1994.

55 miles, 6 in. gas line from Macae to Campos to supply ceramics and power generation uses. Completion: end 1994.

213 miles, 16 in. gas line from Rio de Janeiro to Belo Horizonte. Completion: Rio-Juiz de Fora in March 1995; Juiz de Fora-Belo Horizonte in mid 1995.

600 miles gas line from Urucu gasfield east to Manaus for power generation in Amazonas state in planning stage.

CASPIAN SEA

There is considerable attention being devoted to pipeline transportation options for Azeri and Kazakh oil from the Caspian Sea region and to Turkmen and Kazakh natural gas transportation.

CHILE

GAS DE CHILE. 750 miles gas line from Nuequen fields in Argentina to Santiago in Chile. 5000 miles gas distribution system for Santiago and other cities. Construction of gasfired power generation facilities. Rival schemes advanced by British Gas/Tenneco/Chilectra (Trans Andean project) and by NOVA (GasAndes project).

CHINA

CHINA NATIONAL OIL CORP. 438 miles, 28 in. subsea gas line from Yacheng 13-1 to Hong Kong Castle Peak Power Co. Completion: December 1994.

556 miles gas pipelines from the Shaanxi-Gansu-Ningxia field to Beijing. Construction start: First half 1995. Completion: 1998. Basic Design: PLE of Germany. Detailed design: SPA (with PLE).

190 miles, 8-24 in. gas line under construction from Yungan to Tunghsiao. Completion: 1995.

196 miles, gas line from Jingbian to Yinchuan under consideration by central government.

372 miles gas line from Jingbian to Xtan under consideration by central government.

COLUMBIA

ECOPETROL. 357 miles, 18 in. gas line from Ballena to Barrancabermeja. Completion: end 1995. Enron will build, own and maintain.

58 miles, 12 and 14 in. gas line from Vasconia to La Belleza. Completion: 1995.

97 miles, 10 and 12 in. gas line from Sebastopol to Medellin. Completion: 1995.

224 mile, 18 in. gas line from Mariquita to Cali. Completion: 1996.

PROMISGAS SA. 373 miles, 20 in. and 2,459 miles, 24 in. gas line from Pajaro to Bogota under study.

7 miles, 4 in. gas line from main gas pipeline to Montelibano. Planned.

9 miles, 3 in. gas line from main gas pipeline to Corozal. Planned.

12 miles, 4 in. gas line from main gas pipeline to Arjona. Planned.

5 miles, 3 in. gas line from main gas pipeline to Galapa. Planned.

9 miles, 4 in. gas line from Barranquilla to Puerto Colombia. Planned.

DENMARK

DANSK OLIE OG NATURGAS. 5 miles, 12 in. gas line from Kalvebod to HCV power plant under design.

15 miles, 12 in. gas line from Milov to Synnemollen under study.

NATURGAS SYD. 2,435 miles expansion of gas distribution system for southern Denmark.

EGYPT

EGYPTIAN GENERAL PETROLEUM CORP. 120 miles, 16 in. gas line from Shoukare to Suez. Completion: 1994. Contractor: Petrojet

103 miles, 18 in. gas line from El Eaafrana to Kurimat. Completion: December 1995. Contractor: Petrojet.

50 miles, 22 in. gas line from Kurimat to Tibeen. Completion; June 1996. Contractor: Petrojet.

330 miles gas line from Egypt to Israel and Palestine dependent on Middle East peace process.

FINLAND

NESTE OY. 26 miles extension of the company's southern Finland gas line into Greater Helsinki. Contractor: E.M. Pekkinen Oy. Welding and fitting by Zarubezhjneftegasstroi (Russia).

160 miles gas line crossing the Baltic Sea from Unslkaupunki, Finland to Gravle, Sweden under discussion.

FRANCE

GAZ DU SUD-OUEST. 110 miles, 32 in. gas line from Toulouse to Narbonne-Argeliers. Completion: end 1994.

30 miles, 12 in. gas line from Toulouse-Selih to St. Sulpice. Completion: end 1994.

25 miles gas line from Perpignan to Amelie le Bains. Completion: end 1994.

GERMANY

RUHRGAS AG. 115 miles, 42 in. gas line from Salzwedel to Bernau. Completion: December 1994. (Joint venture with Verbundnetz Gas). Contractor: Pipeline Engineering GmbH.

16 miles, 16 in. gas line from Laimerstadt to Denkendorf. Completion: end 1994.

5 miles, 12 in. gas transmission loop between Bonn and Euskirchen. Completion: end 1994.

51 miles, 48 in. gas line from Achim to Wardenberg. Completion: end 1994. (Joint venture with BEB Erdgas and Erdol).

8 miles, 12 in. gas distribution lines in the Messenkamp area. Completion: end 1994. Contractor: Pipeline Engineering GmbH.

99 miles, 32 in. gas line from Breitbrunn to Anwalting. Completion: end 1995. (Joint venture with Bayerngas GmbH).

74 miles, 44 in. gas lines between Drohne and Werne. Construction during 1995.

35 miles, 48 in. gas line from Etzel to Wardenberg. Construction during 1995.

BAYERNGAS GM. 53 miles, 28 in. gas transmission (and distribution) lines at Nordumgehung von Munchen. Completion: October 1995.

43 miles, 32 in. gas line from Lehringen to Kolshorn. Completion: October 1994.

75 miles, 24 in. gas line from Kolshorn to Egenstedt. Completion end 1994.

10 miles, 8 in. gas line from Bramsche to Neuenkirchen planned.

GASVERSORGUNG SUDDEUTSCHLAND GmbH. 16 miles, 20 in. gas line from Scharenstetten to Allmendlingen. Completion: October 1995. Engineers: ILF Munchen.

19 miles, 16 in. gas line from Pfullendorf to Neuzingen. Completion: October 1995.

PREUSSAG ANLAGENBAU GmbH. 33 miles, 24 in. gas line from Ahltan to Saltgitter. Completion: early 1995.

TRANS EUROPA NATURGAS PIPELINE GmbH. 14 miles, 40 in. gas line between Mittelbrun and Merzalbau. Completion: end 1994.

10 miles, 40 in. gas line between Schwarzach and Rheinbischofsheim. Completion: end 1994.

GREECE

DEPA. 257 miles, 30 in. gas line from Bulgarian border town of Kulati, over Thessalonica to Koula. Completion: 1994.

62 miles, 36 in. gas line from Koula to Athens. Completion: end 1994. Contractor: Machinoimport/Biokat.

44 miles gas line from Ptolemias to Greek/Albanian border.

22 miles, gas distribution lines in northern Attica. (Joint venture with PEDRA-Attica).

HUNGARY

HUNGARIAN OIL AND GAS CO. LTD. (MOL LTD). 38 miles, 16 in. gas line from Szank to Kalocsa. Completion: 1994.

23.4 miles, 16 in. gas line from Kalocsa to Szekszard. Completion 1994.

42 miles, 28 in. gas line from Gyor to Austrian border (Oh). Completion: 1995.

49 miles, 32 in. gas line from Hajduszoboszlo to Endrod. Completion 1996.

21 miles, 28 in. gas line from Szank to Varosfold compressor station. Completion: 1996.

60 miles gas line from Baumgarten, through eastern Austria to Sopron in Hungary, and on to provincial capital Gyor. Baumgarten to Vienna could be achieved by looping or adding compression on the TAG line that carries Russian gas across Austria to Italy. Vienna to Gyor would require a new line. MOL and Austria's OMV are plannng for end - 1995 completion.

INDIA

GAS AUTHORITY OF INDIA LTD. (GAIL). Plans a 11,400 miles national gas grid. A feasibility study is being called for by the more modern states.

310 miles, 36 in. gas line from Bijaipur in Madhya Pradesh to Dadri in Uttar Pradesh. Completion: 1998. Consultant: Engineers India Ltd.

152 miles, 42 in. gas line from Bassein (offshore Arabian Gulf) to Hazira, near Bombay. Completion: end 1994.

OIL AND NATURAL GAS COMMISSION (ONGC). 88 miles, 30 in. ICP Heera gas line project off Bombay. Contractor: NPCC Singapore.

30 miles, 8-12 in. gas line in offshore Bombay High area. Completion: 1995. Contractor: John Brown Engineering.

INDONESIA

1,102 miles, 24 in. and 30 in. offshore gas lines in Block B fields, South China Sea to Marak Islands to Bantam Island to Duri oil field in Sumatra planned - phase one 839 miles and phase two 413 miles Stage II of the Trans Java system.

PERUM GAS NEGARA. 530 miles gas line from the Asamera field in central Sumatra to Caltex oil field in Riau and Bantam Island. Construction start: 1996.

300 miles gas line from Pertamina gas field in south Sumatra to Cilegon in west Java. Construction start: 1998

260 miles gas line in west Java linked to offshore fields planned.

170 miles gas line from Sengkang field to Ujungpandang in south Sulawesi planned.

172 miles gas line extensions in east Java planned.

SHELL OVERSEAS INVESTMENT. 280 miles gas line between central Java and southern central coastal Java petrochemical plant near Cilacap. Completion: 1995/96.

IRAN

NATIONAL IRANIAN GAS CO. 2,050 miles gas lines from Iran's Kangan field to Pishin, Pakistan under consideration.

4,000 miles gas lines from Iran to Turkey under consideration.

200 miles gas line from Esfahen to Yazd. Completion: 1994

IRELAND (Republic of)

BORD GAS EIREANN. 147 miles (126 miles subsea), 24 in. gas interconnector from Moffat, Scotland to Ballough, County Dublin. Completion and first gas deliveries in 1994.

ITALY

A consortium of Total, OMV (Austria), INA (Croatia), Petrol Zemeljski (Slovenia), MOL (Hungary), CPP (Czech) and SPP (Slovak) has been formed to double the capacity - through additional compression - of the Transmed gas pipeline. Completion: 1996

JAPAN

2,050 miles, plans for a trans-Asia gas pipeline network from Russia to Southern Japan (and possibly later to Indonesia and Australia). Plans hinge on developments of Sakhalin Island offshore reserves. Alternatively, 2,700 miles, plans for gas lines from the Yakut field via northern Russia and the Koreas to Kyushu, western Japan. Completion: earliest 2005.

155 miles, 20 in. gas line from Niigata on the Sea of Japan coast, across the central mountain ranges, to Sendai on the Pacific coast. Completion: 62 miles in 1994, 62 miles in 1995, 31 miles in 1996. (This is the first segment of a 2,050 miles gas network extending from Hokkaido to Kyushu. Completion: 2005).

JORDAN

217 miles gas line from Al-Risha field to Azzarqa under government consideration.

KOREA

KOREA GAS CORP. The government has approved an agreement between South Korea and Russia for a feasibility study for a gas line from Yakutsia, east Siberia, to South Korea crossing north east China and North Korea. A South Korean consortium comprising Pedco, Daewoo, Yukong Oil, Samsung and Lucky Goldstart has been formed to take part in the project.

820 miles gas lines to South Korea's central and west coast area. Construction underway.

186 miles, 20 in. gas line from Pyongtaek to Kwangju planned.

LIBYA

ENI. 3,278 miles North African gas network from the Sirte Basin, Libya westwards to Mauritania and eastwards through Egypt to the Arabian Peninsula for access to export facilities. Under review.

417 miles gas line from Misratah to Knoms under study.

MACEDONIA

MAKPETROL. 62 miles, gas line from Kriva Palanka, on the Russian/Bulgarian border, to the Macedonian capital of Skopje. Completion: 1995. Plans to extend line to Albania.

MADAGASCAR

220 miles gas line from offshore West Manambolo field to the mainland planned and awaiting financing arrangements.

MALAYSIA

PETRONAS GAS. Peninsular Gas Utilisation project, phase III - 398 miles gas line from Meru in Klang, Selangor to Bukit Ketari, Perlis with laterals to Bukit Kaya Hitam and Yan in Kedah, Pari in Penang and Lamut in Perak. Completion: 1997. Contractor: Saipem.

OFFSHORE PIPELINES INC. 255 miles 36-38 in. gas lines offshore Sarawak to onshore facilities at Bintulu.

MOROCCO

SONATRACH. 338 miles leg of the Maghreb-Europe gas line between Berguent on the Algerian border and the Straits of Gibralter. Completion: 1996. Contractor: Bechtel.

MOSAMBIQUE

ENH. 560 miles, 16-24 in. gas line from the Pande gas field to Secunda, near Johannesberg planned. Spur lines 375 miles Ressano Garcia and 335 miles Badplaas to Maputo under study. Contractor: Sasol Ltd.

MYANMAR (Burma)

250 miles subsea and 62 miles onshore gas lines from Gulf of Maturban field to Bangkok. Possible extension 242 miles south east of Bangkok to planned 2100 MW combined cycle power plant. Construction timing dependent on gas field coming onstream in 1998. Contractors: Total and Unocal.

THE NETHERLANDS

NV NEDERLANDSE GASUNIE. 7.7 miles, 12 in. gas line from Oldboorne to Opsterland. Completion: end 1994

9.6 miles, 48 in. gas line from Angerlo to Maalderen. Completion: end 1994.

15.6 miles, 36 in. gas line from Oudisluis to Alkmaar. Completion: end 1994.

5.4 miles, 48 in. gas line from Halldesen to De Grift. Completion: end 1994.

12.4 miles, 18 in. gas line from Zegge to Moerdyh. Completion: end 1994.

37.3 miles, 48 in. gas line from Zweekhorst to Ravenstein. Completion: end 1994.

3.2 miles, 48 in. gas line from Oudbosch to Woezik. Completion: October 1995.

26 miles, 48 in. gas line from Grijpskerk to Garrelsweer under study. Completion: October 1996.

UNOCOL TRANSPORTATION. 40 miles, 12 in. gas lines (offshore) from the Horizon Platform to the Helder Platform. Completion: spring 1995. Engineering services contractor: John Brown/Tectech.

ELF PETROLAND BV. 5 miles, 6 in. gas line from K5D platform to K5A platform. Completion: summer 1994.

NEW ZEALAND

WESTERN MINING CORP. 22 miles gas line from offshore Kupe oil and gas field to Taramaki open for bidding in 1995. Completion: 1997.

SOUTHGAS RESOURCES. 62 miles gas line in the Invercargill area in planning stage.

112 miles gas line in the Dunedin area in planning stage.

SHELL BP AND TODD OIL SERVICES. Dual 19 miles, 24 in. gas lines from the Maui field to shore proposed.

276 miles offshore gas line from the Maui B platform to Taranaki proposed.

MINISTRY OF ENERGY. 145 miles, 12-20 in. gas lines from Huntly to Marsden power station near Whangare under consideration.

NIGERIA

SAIPEM. 54 miles, 14 in. and 24 in. gas line in the Ikot Etetuek area. Engineering: Snamprogetti.

NIGERIA LNG LTD. 136 miles, 20-36 in. gas transmission (and gathering system) lines from Bonny Island to River State. Engineering: Snamprogetti.

1,100 miles gas lines originating at Escravos River and passing through Niger, Benin, Togo and Ghana planned by the Economic Community of West Africa.

NORWAY

STATOIL. (Phase IIA Zeepipe) 93 miles, 40 in. gas line from the Sleipner East Field to the new Troll gas processing plant/terminal at Kollsnes, near Bergen, Norway. To be operational April 1996.

(Phase IIB Zeepipe) 400 miles, 40 in. gas line from Kollsnes to Emden. Completion: October 1997. (This replaces previous Sleipner/Heimdal route).

Europipe Development Project. 31 miles, 42 in. onshore gas line and 375 miles, 40 in. offshore gas line from Domumersiel to Emden. Completion: end 1995. Contractor: Suedrohrbau GmbH.

Construction of a fifth gas line is under consideration with landfall in France by 1998.

152 miles, 16 in. gas lines from the Heidrun Field to Teldbergodden (the Haltenpipe system). Completion: end 1996.

OMAN

OMAN OIL CO LTD. 680 miles, 24 in. gas pipes from Ra's al Jifan across the Arabian Sea (deep water depth 11,050 ft.) to Gujarat, India. Possible construction start: mid-1997. Completion: 1999.

INTERNATIONAL PETROLEUM BUKHA Ltd. 22 miles, 16 in. gas line from offshore Kukha field to landfall at Khor Khuwair.

PAKISTAN

CRESCENT PETROLEUM CO. 1,000 miles, 40 in. gas line from the Qatar North Field to Gwadar and Gadani, Pakistan. Completion: 1998 dependent on project financing and 1996 start. Turnkey contractor: Brown and Root.

OIL AND GAS DEVELOPMENT CORP (OGDC). Feasibility study by Bridas Corp. of Argentina on possible gas line from Turkmenistan through Afghanistan to Pakistan.

SUI SOUTHERN GAS CO. LTD. 50 miles, 20 in. gas line from Shikapur to Larkana. Completion: Mid 1994.

75 miles, 24 in. gas line from Kadanwari to Nawabshah. Completion: 1994.

180 miles, 20 in. gas line from Nawabshah to Karachi. Completion: 1994.

117 miles, 18-20 in. loopline projects between Quetta and Jacobadad as part of stage 2 of the Quetta Pipeline Capacity Expansion. Completion: December 1996.

SUI NORTHERN GAS PIPELINES LTD. 26 miles, 16 in. loopline from Sikanderabad to Kot Addu.

45 miles, 16 in loop line from Chiniot to Bhuna.

24 miles, 16 in. loop line from Faisalabad to Shahdara.

16 miles, 18 in. loop line from Uch Sharif to Sutlej.

100 miles, 18 in. main line from Sahiwab-Lhr.

16 miles, 24 in. loop line from Shorkot to Toba Tek Singh.

97 miles, 24 in. main line from Qpr (Rawan) to Sahiwal.

50 miles, 30 in. main line from Qpr to Bhong.

203 miles, 30 in loop line from Sui to Multan.

SUI GAS TRANSIMISSION CO. 311 mile Indus/Right Bank gas plan under study.

500 miles gas line from Multan to Karachi under consideration.

372 miles, 16-30 in. gas line planned.

44 miles gas line between Sui and Pirkoh fields under study.

PERU

PETROLEOS DEL PERU. 364 miles, 26 in., 300 miles, 10 in., 64 miles, 8 in. gas lines from Camisea-Cuzco to Callao-Lima delayed pending outcomes of studies of Aguaytia and Camisea gas fields development opportunities.

225 miles, 6-16 in. gas line from Camisea-Cuzco. Under consideration.

400 miles, 14 in. and 20 in. gas line from Yangas to Pasamayo. Under consideration.

310 miles, 10 in. and 14 in. gas lines from Yangas to Pisco. Under consideration.

56 miles, 6 in. and 14 in. gas and product lines from Aguaytia to Pucallpa. Part of Aguaytia development (phase 2). Completion: 1997.

62 miles, 12 in. gas line from Aguaytia to Tingo Mario power station. Part of Aguaytia development (phase 3). Completion: 1998.

PHILIPPINES

THE FIRST PHILIPPINE HOLDING CORP. Memorandum of Understanding with British Gas allows construction of onshore gas lines, series of power plants and a distribution network to provide necessary gas infrastructure. Gas line form Batangas to Metro Manila for completion in 2001 to align with arrival of gas from the Shell Malampaya discovery.

POLAND

418 miles gas pipeline system across Poland and Belarus from Bovankovo and Kharasavei gas fields on Yamal Peninsula to Western Europe. Work began on the Polish section of 60 miles and the Belarus section of 125 miles in 1994.

PORTUGAL

250 miles high pressure gas lines from Setubal near Lisbon to Braga and eastwards to the Spanish border, where the system will be connected to the Maghreb-Spain pipeline

in 1996. Contractor: Transgas (Joint venture of Gas de Portugal, Caixa Geral de Depositos, Electricade de Portugal and three regional gas distribution utilities).

Regional gas distribution companies Portgas, Lusitaniagas, Setgas and Gas de Portugal have awarded contracts for 397 mile gas distribution network to be supplied from the Setubal to Braga high pressure line. EU grants will be available. Contractors: Mannesman Anlagenbau, Suedrohrbau, GTM-Entrepose and Spie-Capag.

QATAR

Plan to supply Europe with gas from the Persian Gulf. Route could be either crossing Turkey or through Saudi Arabia and Egypt to the Mediterranean.

QATAR LIQUEFIED GAS CO. (QATARGAS). 51 miles, 32 in. gas line from the North Field to feed the LNG plant at Las Raffan.

RUSSIA

Two trans-Siberian lines are in the plannng stage. Each line, from the Yamal Peninsula to Frankfurt-on-Oder in eastern Germany for markets in Europe, would be an estimated 1,864 miles long and would cross Poland and Belarus on the way. (See under Poland for progress in Poland and Belarus). At the start of the system on the west coast of the Kara Sea two gas lines (50 miles, 48 in.) are scheduled (optimistically) for completion by end 1996. Contractor: Pietergas (joint venture of Gazprom and Khirema of Holland).

2,814 mile, 56 in. gas line from Yamburg to Zakavkazye to Gorky.

1,906 miles, 56 in. gas line from Gorky to Talla to Kiev.

1,713 miles, 56 in. gas line from Kiev to Novolzhr.

Repair and reconstruction of 11,000 miles of gas lines in 1996-2000 (15,000 miles in 2000-2005; 16,000 miles in 2005-2010), 2800 distribution stations and 226 compressor stations.

SINGAPORE

PUBLIC UTILITIES BOARD OF SINGAPORE. 43 miles, 24 in. gas pipe between Queenstown, Toh Tuck and Kallang in the south and Senoka power station, Johor Strait, in the north. Completion: 1996. Contractor: McConnell Dowell South East Asia Pte Ltd.

SOUTH AFRICA

SEOKOR. 248 miles gas line from offshore gas fields to onshore landing at Mosselbaai, and on to Cape Town. Under study.

SPAIN

EMPRESA NACIONAL DE GAS SA. 66 miles, 4-14 in. gas line from Oviedo to Tuy in the engineering stage. Distribution lines for Ferrol, Coruna and Santiago de Compostela. Contractor: INITEC.

112 miles, 20 in. gas line from Oviedo to Tuy in the engineering stage. Contractor: INITEC.

40 miles, 26 in. gas line from Ferrol to Villalba (Lugo) in the engineering stage. Contractor: INITEC.

ENAGAS. 256 miles gas line from Valencia to Alicante. Completion: end 1994. Contractor: Technicas Reunidas/Heymo Ingeniera.

107 miles, 8-12 in. gas line from Cordoba to Jaen-Granada in engineering stage. Completion: December 1995. Contractor: Technicas Reunidas/Heymo Ingeniera.

242 miles, 20 in. and 40 miles 26 in. gas line in Galicia in engineering stage. Completion: July 1997. Contractor: INITEC/Intecsa.

180 miles, 48 in. gas line from Tarifa to Cordoba in engineering stage. Completion: 1995. Contractor: Heymo Ingeniera/Mannesman. (Part of Maghreb Pipeline).

50 miles, 16 in. gas line in Campo Gibralter in engineering stage. Completion: December 1995. Contractor: Heymo Ingeniera.

New gas line to distribute gas for industrial use in the Toledo area. Contractor: Obramin (joint venture of Obrascon and Amingapesa).

REPSOL PETROLEO SA. 218 miles, 10 in. gas/products line from Cartagena to Puertollano. Completion: April 1996. Contractor: INITEC.

70 miles, 8 in. gas line in Albatross gasfield linking Gaviota field platform. Completion: end 1994. Contractor: Sten Offshore.

SWITZERLAND

GASVERBUND OSTSCHEWUIZ AG. 29 miles 20 in. gas line from Ohringen (Winterhur) to Bischofszell. Completion: 1995

2 miles, 10 in. gas line from Mettlen to Weinfelden. Completion: 1995

SYRIA

Gas gathering system for the Audah, Kahtaniyah and Lailak fields planned. Contractor: SPC.

273 miles, 18 in. gas line from Omar/Tanak fields to power stations at Tishrin and Mahrada.

TAIWAN

CHINESE PETROLEUM CO. 143 miles gas line from the Yungan LNG terminal to Taiwan Power Co. Construction start: 1995

179 miles, 24 in. gas line between Tung-Shiao and Kao Hsiung planned.

THAILAND

PETROLEUM AUTHORITY OF THAILAND (PTT). 264 miles, 36 in. (second) offshore gas line from Erawan to Mab-Ta-Pud. Completion: 1996. Contractor: Bechtel.

70 miles, 28 in. gas line from Mab-Ta-Pud to Bangkok. Completion: 1996. Contractor: Bechtel.

62 miles, 28 in. gas line from Bang Pakong (branching out from PTT's second offshore/onshore line) to Wang Noi in Ayutthaya. Completion: 1995.

100 miles, 24 in. gas line from Erawan to Khanon. Completion: 1994.

242 miles, 24 in. gas line from Nam Phong field to existing Bangkok-Saraburi line planned.

437 miles, 18-24 in. gas line between Khonkaen and Chou Buti provinces planned.

TUNISIA

SCOGAT. 228 miles, 48 in. gas line. Tunisia section of the Algeria-Italy Transmed. pipeline expansion study. Completion: 1995. Contractor: Snamprogetti.

SOCIETY TUNISIENNE DE L'ELECTRICITY AND DU GAZ. 82 miles, 20 in. and 66 miles, 24 in. gas line from M'Saken to Gabes, including 4 miles link with Tunis grid. Completion: 1995. Contractor: China National Oil and Gas Exploration and Development Corp.

BRITISH GAS TUNISIA LTD. 78 miles, 24 in. sour gas line from the Miskar field to Sfax. Completion: March 1995. Contractor: Andrews Palmer & Associates.

BOTAS. 2,400 miles, 56 in. gas line to and across Turkey to the Bulgarian border under study by Zangas/Pensren.

TURKEY

BOTAS. 1,118 miles 12 in. gas transmission network under study.

TURKMENISTAN

3,300 miles, 56 in. gas lines (and 14 compressor stations) for gas transmission through Iran, to and across Turkey, and on to the Bulgarian border.

Ashgabat, the Turkmen gas company, is studying with Japan's Mitsubishi and the China National Oil Co. the possibility of a gas system from Turkmenistan to China via Kazakhstan.

UNITED ARAB EMIRATES (UAU)

EMIRATES GENERAL PETROLEUM CO. 50 miles gas line from Sharjah to Dubai in design stage. Contractor: Pipeline Engineering.

217 miles gas line from offshore Bukha field to Sohar under study.

UNITED KINGDOM

BRITISH GAS. 84 miles, 24 in. gas line between Dumfries and Galloway, Scotland to Ballylumford power station, Northern Ireland. 25 miles, 24 in. offshore section from Dumfries to Islandmagee. Construction start: June 1995. Contractor: European Marine Contractors. Detailed engineering: Snamprogetti. Conversion of Ballylumford power station to natural gas by McDermott Engineering by late 1996. New gas transmission line from Ballylumford. EU financial grants available.

150 miles, 40 in.gas interconnector from Bacton, Norfolk UK to Zeebrugge, Belgium. Partners: British Gas (40%), Amerada Hess, BP, Conoco, Distrigaz, Elf, Ruhrgas, National Power, Gazprom. Construction start: 1996. Operations: 2000.

KINETICA. 158 miles, 36 in. gas line from Theddlethorpe to the Isle of Grain (on the River Thames). Completion: 1995.

30 miles, 20 in. gas line from Theddlethorpe to Killingholme (PowerGen power station). Completion: 1995.

New gas trunk line, 48 in. from St. Fergus, Scotland to Bacton, Norfolk under consideration.

UK Government approval to proceed for the Britannia gas field development will call for significant new gas pipeline systems.

URUGUAY

Planned Argentina to Uruguay gas line. 30 miles Buenos Aires to Colonia, Uruguay. 105 miles, 16-18 in. Colonia to Montevideo.

UZBEKISTAN

56 miles gas line from the Gazli deposit near Bukhara to Khorezm and Karakalpakistan in the northern region in the planning stage.

VENEZUELA

PETROGAS DE VENEZUELA SA (PDSA). 900 miles gas export line through Venezuela to the Columbia border and on to Bogata: and, 320 miles gas line to connect with an alternative border crossing point. Under consideration.

PETROHAVEN. 26 miles, 12 in. offshore gas line from the Margarita Basin field to shore in Mapire Bay.

Possible 2,000 miles 42 in. high pressure gas line starting off the Venezuelan coast and extending from Trinidad up the Leeward and Windward Islands through Hispaniola, Cuba, Puerto Rica and the Bahamas to Miami. Start date not likely before 2010 at the earliest.

VIETNAM

PETROVIETNAM. 77 miles gas line (66 miles, 16 in. offshore) from White Tiger (Bach Ho) field to the Ba Ria power station at Vung Tau. Completion: late 1994. Contractor: Hyundai Heavy Industries of South Korea. Engineering services: John Brown.

77 miles gas line from Vung Tau to Ho Chi Minh City (together with a compressor station at White Tiger, a 16 in. field to shore pipeline and a liquefaction plant at Vung Tau). Dependent on feasibility study.

434 miles gas line from Dai Hung to Erewan planned.

109 miles gas line from Bachtto to Vuns Tu planned.

YEMEN

372 miles gas line from offshore Alif field to landfall in Yemen under government feasibility study.

Appendix 2

INGAA Foundation Fifth Annual Meeting

REPORT ON INTERNATIONAL GAS PIPELINE DEVELOPMENTS

by
Derek Portsmouth

INTRODUCTION

Natural gas pipeline companies are challenged today in the management of their business with an ever-changing environment. Pipeline systems have successfully moved oil, gas and products since the turn of the century with a good safety and environmental record. Still, several factors have emerged over recent years that are forcing a change to operating methods. These factors include the continued aging of pipelines, the raising of the public temperature for accident and pollution prevention, and, the tendency for lines to be run through more densely populated areas. This latter factor is especially relevant when one considers the potential for major pipeline developments among the millions in, say, south-east Asia or South America. For both pipeline operators and constructors the questions are: What is the financial impact of new requirements? And, What is the price of ignoring or minimising the response to the new safety and environmental pressures?

Being alert to the need for constant inspection is part of the solution. During 1994 British Gas launched a new business unit -Pipeline Integrity International -to market its pipeline technology skills worldwide. The unit provides a full unified pipeline service, ranging from inspection, through assessment, to repair. It is estimated that there are 9 million miles of oil and gas pipelines worldwide that need maintenance. Although an operational matter, due to the imperatives of safe pipelines and keeping down costs, there are clear planning implications for the quality and standards of construction for new international pipelines.

As far as actual gas pipeline construction statistics are concerned, it is very much an industry of peaks and valleys. Just looking at 1993 and the forecast for 1994 it is clear that the big gain for 1994 is in the "international" business where activity is estimated at 8,893 miles with a value of $10.35 billion against only 2,434 miles last year. Industry sources are pinning hopes on a stronger 1995.

The exciting actuality is that gas is the global fuel of choice. But, before the profits from transporting it are counted, it will be prudent, ahead of a survey of activities, to make the briefest of analyses of the realism of the world demand for gas.

GAS DEMAND

Let us start by recognising that the shape and size of world energy demand is increasingly being determined not by the rich countries but by the fast growing developing countries of Latin America and Asia. Just as the oil producers in OPEC achieved sudden prominence after more than a decade of obscurity, so the full effect of the shift among consuming countries will not be felt for many years. But it is equally inexorable; and no less far reaching.

The World Energy Council has recently published some energy scenarios for the year 2020. The high growth case, simply put, shows that annual world energy demand could be double today's level. Amazingly, the message for gas is that demand will reach, for the study year, almost as much as America's current gas reserves. Equally clear is the growing importance of developing countries in the shape of demand. Now, ally to this the expert opinion that gas is likely to be used wherever it is found. With large reserves in Indonesia, Malaysia and Brunei, gas remains under-exploited in all Asian countries except Japan, Taiwan and South Korea. There are ambitious proposals for pipelines from the Middle East to India and from the Russian Far East to China. Until recently the fuel was a consolation prize for not finding oil. Now it is being explored for in its own right and the signs are that it will turn out to be more common than anyone imagined.

GAS DOMINANCE

Satisfied about the demand for gas let us now widen the scope to pick up several developments which are evidence of this move to gas dominance. These include the explosive growth in proposals for developing gas supplies and markets; the tilt to gas in national energy policies; the planning and building of import/export pipelines; the expansion and regionalisation of domestic gas distribution grids; and, the seemingly endless supply of new LNG proposals. Three major trends are apparent:

First: Gas markets are developing along continental or subcontinental lines. These markets will rely primarily on pipelines to bring gas to market where Europe is following North American experience with its plans for a comprehensive European pipeline grid drawing supplies from the Russian Arctic, the North Sea and Algeria. In Asia, proposals for a Regional pipeline grid have surfaced and could eventually link gas markets in Japan, Korea, Taiwan, and elsewhere to supplies from Australia, Alaska, the former Soviet Union and points in between. In South America, pipeline linkages are being developed on a bilateral basis - Columbia/Venezuela, Bolivia/Brazil, Argentina/Chile. A South American gas grid lies well into the future and faces significant geographic and environmental obstacles, but it is not an impossibility.

Second: LNG will provide interregional supplies until these pipeline grids are in place and intercontinental supplies thereafter. Arguably, competition between LNG and pipeline gas could ultimately become as significant as competition between gas and other fuels in setting gas market prices.

Third: The general trend toward competition and privatisation of government enterprise has affected the gas industries of many nations and opened opportunities for a newly emerging group of international gas companies: British Gas, Spain's Gas Natural, Gaz de France, Russia's Gazprom, following the pattern of such US companies as Enron, Utilicorp and Brooklyn Union Gas.

But, this optimistic picture has to be balanced with some notes of caution. Inevitably these centre on the nationalism and protectionist sentiments which have surfaced in Europe deferring immediate hope of open access to continental pipeline transportation in Europe. Equally important, in many parts of the world actual political instability or lack of future political clarity threatens the viability of new gas supply projects in, for example, the former Soviet republics and Algeria.

To summarise at this stage of the report: Shifts in political movements as well as energy consumption patterns will continue to influence worldwide energy pipeline activity. At the same time as formerly planned economies develop pipeline infrastructure to serve new markets, industrialised as well as developing countries are developing strategies to diversify their energy sources. The development of massive energy reserves in the Middle East and the Former Soviet Union will require new pipelines and the overhaul of existing systems. A continued preference for natural gas throughout the world will be a significant spur to pipeline construction well past the year 2000.

PIPELINE DEVELOPMENTS BY REGION

The report continues with a tour d'horizon of the major international pipeline developments as covered in trade and industry source materials.

EUROPE

Europe, primarily for advanced industrial reasons, is the most mature and sophisticated region in terms of gas pipelines. Gas demand of 13.5 trillion cubic feet back in 1991 could increase to nearly 20 tcf by the year 2010. On this basis, construction could be sparked of more than 23,000 miles of new international pipelines in and to Europe, costing up to $100 billion. Today, the extent of the European transmission system is something under 150,000 miles of 12 to 48 inch lines. When broken down by exporting countries, 57% of the total mileage transports gas from Russia, 20% from Algeria, 15% from Norway and 8% from the Netherlands. The big-inch international lines in this total are more than 7,500 miles, increased to 18,600 miles when the major export lines from the former Soviet Union are included.

Forecasts for developments on the UK Continental Shelf continue bullish. Already about 3,500 miles of pipeline are associated with 58 developed fields and a new report by a Scottish Regional Council predicts more than 80 further fields will be developed over the next 20 years. That is both encouraging and important.

Not only important but actually historic, is the fact that this year marks the first time that the Republic of Ireland has been linked to the UK by a state-owned subsea gas pipeline while, for Northern Ireland, the decision has been made by British Gas to build a subsea gas supply line - again a first across the Irish Sea - to Belfast. The line to the Republic is 170 miles long, 120 miles subsea and the overall cost $380 million towards which the European Union will contribute grant aid of $136 million. The 80 mile Northern Ireland interconnector - 25 miles of it offshore - is costed at $200 million and flagged for completion in mid-1996. This pipeline is part of a power station gas conversion project which will receive financial assistance from the European Union Regional Development Fund.

Next, some comments about another prospective landmark in European gas pipeline history. After the Channel Tunnel set the precedent of linking the UK to the Continent, we are on course for a positive decision to build the 129 mile interconnector between Bacton on the east coast of England to Zeebrugge in Belgium. This ambitious $435 million project is sponsored by a group of international energy companies including BP, British Gas and Conoco.

Now, let us move across the North Sea to Norway. Earlier this year, in April, the 503 mile long Zeepipe system - the world's largest offshore gas trunkline - was officially opened,

marking a turning point in the history of Norway as a gas nation. This line comes ashore at a terminal at Zeebrugge and is one element of the infrastructure from the giant gas fields - Sleipner and Troll - to the Continent. The Troll/Sleipner contracts have implied an investment of over $18 billion in field development and pipelines, the Zeepipe opening marking just one phase of the project.

Three new pipelines, either under construction, or on the drawing board, will yield improved transport capacity and flexibility. Construction has started on Europipe 1, a 272 mile 40 inch line supplying Troll gas to the German market from 1996. This is phase two. Phase three could be ready at the beginning of the next century and will include new field developments and new pipeline infrastructure. A number of options are being studied including a second Europipe for Germany and growing central Europe markets, and, a further Zeepipe to meet French market needs. Actually, it is more a matter of priorities and the betting is on a Zeepipe landing in Northern France so as to take advantage of emerging Spanish and Portuguese markets.

The beauty of these latter markets is that the gas industry is either new or starting from scratch with enormous potential for power generation. The Europe - Maghreb Pipeline is due to become operational in 1996. The line will eventually stretch 895 miles from Algeria's Hassi R'Mel fields to Cordoba in Spain and on into Portugal. The first phase of 338 miles, almost all in Morocco, is under construction as is the 29 mile dual 22 inch pipe crossing the Straits of Gibraltar where water depths reach 1,300 feet. The final planned phase, to Cordoba, represents 170 miles of 48 inch pipe.

There is political unrest in Algeria but it is thought even fundamentalists will not blow the country's one real chance of economic survival. The project is an excellent example of European gas industry cooperation. The total cost of $2 billion breaks as $700 million for the Algerian link, $1 billion for the Moroccan link and $300 million for the Spanish link with 40% of the total being financed by the European Bank of Investment.

Clearly there is a lot more happening in Europe. Talks continue between Statoil and Neste about a gasline from Norway to Finland across central Sweden and, also, for a 160 mile line crossing the Baltic Sea to link Finland and Sweden. There are early reports about a gasline to link Bulgaria and Iran via Turkey, and for a 75 mile line between Austria and Hungary. Lastly, Poland and Russia have agreed to build a 2,500 mile pipeline from fields in the Yamal Peninsula in Northern Russia to Frankfurt-on-Oder in Eastern Germany, crossing Poland and Belarus on the way.

FORMER SOVIET UNION

In this regard it is difficult to get at the facts with any accuracy - and more so to reach judgements on the timing of possible developments. So, coverage is restricted to a few highlights.

What is certain is that Russia must upgrade its existing pipeline system. The supply system comprises about 133,000 miles of gas lines, over half sized between 42 and 56 inches diameter. It is estimated that 50,000 miles of line need to be repaired or rebuilt. Progress on modernisation is delinquent due to lack of finance. However, Italian banks have now agreed to support a $1.6 billion loan in exchange for delivery of appropriate quantities of Russian gas to SNAM over 20 years starting in 1995. Also encouraging is the news that

construction of the first part of the 3,000 mile gasline system to connect the remote Yamal peninsula to western Europe has started in the north of the peninsula. As well as the laying of a 125 mile line across Belarus, 62 miles is being laid in Poland. Eventually, the giant Kara and Bovan gas fields will be developed with gas exported via a six 56 inch gasline system timed for 2010 operation. Total cost is put at $12 billion.

The new central Asia republic of Turkmenistan is at the centre of a series of ambitious pipeline projects aimed at exporting its massive gas reserves of some 350 tcf to new markets. Much noise has been heard this year about a line routed from the Amu Darya basin in Turkmenistan through Iran to Turkey and then on into Europe. A transmission system 3,300 miles long, requiring two parallel 56 inch lines and 14 compressor stations and costing $10 billion, such a development faces high hurdles, notably from Russia. Long term realism indicates that central Asian countries may have to go for supplying Europe via Russia. Otherwise they must look southwards to Pakistan. Indeed, in addition to the European project, Turkmenistan has also considered the possibility of sending gas to India and China.

Before moving on from the former Soviet Union, reference is made to some interesting feasibility studies which may just be markers for the future:

(1) Japanese specialists are studying possibilities of building a 16,000 mile trunkline to move gas from eastern Russia to the western coast of Australia, picking up Japan, China, Malaysia and Indonesia along the way.

(2) Japan and US consultants are studying construction of a 4,500 mile gas pipeline from Siberia to Tokyo.

(3) The Shtockmanovskoya gas-condensate field in the central Barents Sea - in the Arctic, 350 miles off the Russian coast - has been the subject of feasibility studies by a western consortium.

THE MIDDLE EAST

The region from Iran to Egypt - possesses 31.5% of the world's known gas reserves but produces only 5% of world output. A number of countries in the region - notably Qatar, Iran and Oman - are looking to develop their reserves by piping them to new markets. Iran, interestingly, proposes an ambitious internal network of pipes to ring the country with spurs that would take gas in from the Gulf to the southwest and from central Asia to the northeast and push it out to Turkey and Europe in the northwest and to Pakistan and India in the southeast. There is considerable logic to the battery of projects under discussion. What is lacking is any sense of co-ordination, which is vital given the enormous expense that each entails.

In mid-1994 Japanese firms announced that feasibility studies were in hand for the United Nations Industrial Development Organisation into a 4,500 mile line to supply gas to Japan and other Asian countries and to Europe. The pipeline would be a loop passing through Iran, Saudia Arabia, Qatar, Oman, Jordan and Syria. It would be able to deliver to Europe perhaps through an extended line across northern Africa to Morocco and then under the Mediterranean; and, carry gas to Oman for LNG shipment to Japan and elsewhere in Asia.

Some momentum seems to be behind the official Iranian viability study of a new gasline to

Europe passing through Turkey, Bulgaria, a number of other European countries and terminating in France. Gaz de France is deeply involved while there is considerable interest from elsewhere.

However, it is moving gas eastwards - to the Indian Sub Continent - which has produced most noise. There are plans - some of them advanced - for gaslines from Oman to India; and, from Turkmenistan and from Iran and from Qatar to Pakistan. This is not the first but the latest example of pipelinitis - drawing pen lines on maps in the hope that gas lines would soon follow. But, of course, economics and politics must make sense. Turkmenistan to Pakistan seems fanciful given the need for transit through Iran - long, uncompetitive and clashing with Iran's own ambitions - or through Afghanistan with such security problems. Arguably the 1,000 mile proposal from Qatar or Iran to Pakistan and the 650 mile span - across deep water - between Oman and India are not unimaginable given the success with the Maghreb Project. However, the economics of transmission lines, where doubling the diameter multiplies the capacity by four and the cost by less than two, calls for market engineering. No big pipeline project is commercial without large volumes, quick build up, good load factor and believable hard currency take or pay. The obvious solution is for India and Pakistan to co-operate in providing the markets to underpin the economics of these long distance pipelines. But try and tell that to the politicians!

SOUTHEAST ASIA and the FAR EAST

The burgeoning millions of the countries of Southeast Asia and the Far East are thirsty for power - electric power - and for the fruit of industrialisation. The disease of pipelinitis - in this case, grand designs of spectacular imagination described as the Trans ASEAN Pipeline and as the Trans Asia Natural Gas Pipeline -have been succeeded by a measured series of practical, viable and often cooperative distribution projects which have the potential to serve as major links should the grand designs return to favour. The first of these systems was conceived as 5,000 miles in length connecting six countries within the ASEAN area, while the second involved six international trunk lines linking 15 supplying, transporting and consuming countries with a total length of 26,000 miles. In fact, the second system subsumed the first.

In Malaysia a 310 mile line running along the west coast of the Malay Peninsula is being built for completion in 1997. Similarly, in Thailand, work proceeds to construct a second Erawan gas field to Bangkok offshore/onshore pipeline. The 330 mile line will cost $670 million and should be ready in 1996. Thailand's next major project could be a link to Bangkok from Myanmar's - Burma's -Gulf of Maturban gas field, but there are decided risks of local guerilla activity to be borne in mind. Both Thailand and Malaysia have national gas ring projects in hand to feed residential and industrial markets.

In Indonesia there are plans to build four new gas pipelines worth $1 billion to increase gas sales to Sumatra, Java and Sulawesi. Their total length will be 1400 miles. Phased construction should start in 1996 with extensive funding support from the Asian Development Bank and the World Bank. Completing the ASEAN loop the Philippine authorities are considering investing up to $900 million in a natural gas pipeline to bring gas from offshore to the main island of Luzon which suffers an acute shortage of electricity.

In Vietnam work has begun on laying the country's first offshore gas pipeline. The $100

million line stretches 75 miles, mostly offshore, and when complete at the end of the year will fuel turbines at the Ba Ria power plant. A second stage, costing $400 million, includes a gas pipeline into the Ho Chi Minh city. Significantly, a consortium including British Gas and TransCanada is currently studying ways of opening up the Vietnamese gas market.

The position regarding direct pipeline supplies of natural gas to Japan remains inscrutable. Numerous proposals have been made and a number of schemes are under consideration but it seems MITI is giving priority to a national strategy for gas utilisation development to take Japan into the next century. I will say no more. The position for China is a little clearer although dominated by the grand design syndrome of linking into Turkmenistan. However, there are plans to lay 500 miles of pipeline to Beijing from the Shaanxi gas field.

Then, in the South Pacific, Australia offers a healthy gas line potential of 5,000 miles as the country seeks to expand the national grid to develop competitive energy markets. Of special interest is the proposed $400 million Goldfields Gas Transmission project running through Western Australia.

SOUTH AMERICA

The last port of call on this tour of international pipeline developments is South America where regional pipelining ranks among the most interesting in the world given the history of nationalist governments and long standing disputes over international borders. Major pipeline ventures which have laid dormant for a decade are now under active consideration due to the new mood of liberalisation and encouragement of foreign investment. Of course, operating conditions often pose immense problems - geographic, environmental and security.

Chile wishes to diversify its energy base and improve environmental standards in Santiago. The Trans-Andean Gas Pipeline Project is currently under study by British Gas, Tenneco Gas and Chilectra. The Project comprises a 750 mile transmission line from abundant contracted gas reserves in Western Argentina over the Andes to the major Chilean population centres of Santiago, Valparaiso and Concepcion. A distribution system, eventually of 5,000 miles, would service industrial, commercial and residential markets and provide 700 MW of new combined cycle power generation capacity. Total project cost, over 25 years, could be over $1.5 billion.

Other proposals to move Argentina gas involve export lines into southern Brazil - 340 miles - and to Uruguay and Paraguay for which a system stretching over 2,000 miles would be needed. However, Paraguay is also negotiating to receive piped gas supplies from Bolivia but little in the way of detail has emerged about the proposal.

The largest single energy project in South America is the huge 2,270 mile natural gas pipeline from Bolivia to Brazil. This has been a 'pipedream' for a decade and potential investors are decidedly cautious about it still. Nevertheless British Gas and Tenneco Gas are studying it. The grand design would be for the line to start at Santa Cruz, running for a third of its total length in Bolivia, before feeding into Brazilian cities as far apart as Belo Horizonte in the north and Porto Alegre in the south. At one stage, longer term plans conceived a vast network of pipes coming off the main artery connecting Uruguay, Argentina, Paraguay, Chile and Peru.

Construction of the Columbian Pipeline is on course with the announcement that Enron is to

build, own and maintain a 357 mile 18 inch gas pipe line between Ballena near Riohacha on the north-eastern coast to the oil town of Barrancabarmeja in the centre of the country. Project cost is in the region of $200 million. This is part of the plan to build a national gas transmission network running as far south as Cali.

This lexicon of gas pipeline developments finishes with a V. V for Venezuela where two proposals are being considered to export gas to Columbia. One is a 900 mile line from western Venezuela to the Columbia border and on to Bogata, and the other is a 320 mile line to connect from the first line to another border crossing point. Information is slow in emerging about these proposals.

CONCLUSION

At every historical stage in the development of the energy industry, specific priorities were selected and typical problems solved on the basis of existing levels of achievement in science and technology. As we have seen, technical renovation is a present priority. Energy efficiency is another. As the gas demand analysis has shown we are ready for the Era of Gas.

Scottsdale, Arizona
November 11, 1994