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NATURAL GAS COMMERCIALISATION IN SOUTH AMERICA AND ITS ROLE AS A REGIONAL INTEGRATION FACTOR

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SUMMARY

This paper reviews the development of the existing natural gas businesses in various parts of the world. Lessons that have been learnt are used as pointers to assist in further development of the gas potential in South America. The healthy prospects for gas in South America are reviewed together with the provisions that are essential for gas business development in the future.

1. THE DEVELOPMENT OF THE NATURAL GAS BUSINESS WORLD-WIDE

The patterns of development of the natural gas businesses in various parts of the world are useful precedents when assessing prospects and challenges for natural gas in both existing and developing markets. Examples illustrating the successes, and also any lessons to be learnt, may be given as follows.

North America

During the latter part of the last century and through the early part of this one, relatively small-scale, localised development of manufactured gas and natural gas occurred in parallel in the USA. The former was chiefly used for illumination purposes whereas the latter was utilised for industrial and heating applications.

The advent of long distance pipeline technology in the 1940s permitted gradual displacement of manufactured gas and rapid growth in the natural gas market when the major natural gas producing areas in the south could be linked to the consuming areas nation-wide. The developing USA natural gas transportation system played a major role in this market growth. In 1950 the total length of the natural gas transportation pipelines in the US was over 160,000 km. By 1966 the

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system length had doubled and natural gas was available in all of the lower 48 states. Thus in the course of 25 years the gas market in the USA developed from local supply to a situation where nearly all states were linked for gas trade to mutual economic advantage.

Natural gas trade between the USA and other countries also developed but somewhat later than internal, interstate trade. Short-haul exports and imports occurred with Mexico for logistical reasons. More fundamental imports into the USA of pipeline gas from Canada took place. Also LNG was exported from Alaska to Japan, and imported into the USA from Algeria. Since 1958 the USA has been a net importer of natural gas.

In summary, the gas market in the USA has developed over the decades to become the world's largest gas market. Supply increased to fulfil demand, with gradual introduction of longer distance transportation of gas to enable the available supply to reach more distant markets. Surprisingly, for a country recognised as a leading free market, natural gas development occurred in the USA under strong federal and state legislation. International trade of natural gas using land or sea transport developed in due course in addition to the indigenous USA and Canadian natural gas businesses.

Most of the natural gas projects in North America that passed from the study phase to committed development were successful in covering the needs of buyers, sellers, and transporters. Major commercial problems did however occur with most of the committed and firmly planned LNG trade between Algeria and the East Coast USA reception terminals (and to a lesser extent with the European trade). These commercial problems arose at the end of the 70s when considerable infrastructure was in place and traded volumes were increasing, and the difficulties were so great that the business was disrupted, some projects were aborted, and others were never again to achieve the planned dimensions. This is a salutary reminder that successful natural gas projects have to serve a community of interests. Where this is lacking, for whatever reason, and where the differences between the parties are great, projects can stall even after investments are made.

Europe

Natural gas production in the European USSR began in the early part of the century but only from fields close to the consumption areas. In 1940 nearly 90% of Soviet gas was produced in the Ukraine and consumed in the surrounding areas. Even in 1946, the longest gas transmission

pipeline in the USSR was less than 800 km long. The linking of regions of the USSR by natural gas trade was to develop gradually; as late as the mid 60s over 90% of Soviet gas was both produced and consumed west of the Urals.

Elsewhere in Europe, the development of the natural gas industry awaited the discovery by Shell in the Netherlands of the Groningen gas field in 1959. By 1963 further appraisal confirmed this as a huge field by international standards. Shell-interest companies were established for development of natural gas production, transmission and distribution. Living standards at that time in the Netherlands involved household heating, even during severe winter weather, by a coal stove in a single heated room. Manufactured gas was expensive and used largely for cooking. Conversion of Dutch customers from manufactured gas took place between 1964 and 1968. Further gas market expansion was made possible by extension of the main gas transmission system which by the end of 1977 had grown to a length of 3610 km. This permitted over 60% (today: 80%) of all Dutch homes to be equipped with full central heating. Today, over 99% of all Dutch homes are gas-heated in some way, a clear example of the contribution of natural gas to improved living standards.

International gas projects involving long distance transportation also have a long and successful history in Europe. When the huge size of the Groningen field was appreciated it was realised quickly that this gas should benefit prospective consumers all over Western Europe. During the 1960s, when oil prices were still at a pre-1973 low, large pipelines were built to deliver the Dutch gas to Germany, France, Belgium and Italy. Shell actively participated in this process as well as in setting up national and regional natural gas transmission and distribution companies in Belgium and Germany in addition to the earlier one established in the Netherlands. As is the current situation in South America, such huge resoures could not be commercialised unless, at the same time, the necessary infrastructure and market were developed. Power generation and large industry were initially targeted as the customers. Once the main infrastructure was in place, gas was also piped to smaller industry, commercial and residential consumers. It could easily compete with coal- and oil-derived town gas, a major cooking fuel in most European households. Then the slow and much more difficult process of replacing coal and heating oil for space heating began. It still continues today and, so far, has only been completed in the Netherlands.

By now, the residential and commercial gas markets in Western Europe have, thanks mainly to the space heating demand, grown so much that they now exceed the power generation and large industry markets where gas made its debut.

To return for the moment to the story of Soviet gas illustrates again the development of regional exports and imports as a natural extension of the indigenous market. The USSR actually imported gas for logistical reasons from Afghanistan starting in 1967 and from Iran in 1970. However, supply disruptions from the latter occurred since 1978. The USSR is more noted however for its gas exports which started in 1967, to Czechoslovakia. Supplies to East Germany followed and by 1977 Soviet gas was exported to five COMECON countries. For the USSR it helped progress integration of all COMECON countries and for the buyers it represented a desired diversification of energy supply away from reliance on coal.

The Soviet Union was also ready to supply Western Europe, starting with Austria in 1968, and by 1977 Soviet gas was supplied to Germany, France, Austria and even distant Italy. Again, large investments in infrastructure were needed. The demise of communism left the gas trade relations between Russia and Eastern/Western Europe intact. In spite of the enormous political and societal changes that took place, supplies to Eastern/Western Europe have held up rather well. This clearly illustrates the strength of the economic ties forged by long term gas supply agreements.

Groningen was the drive behind the gasification of the Netherlands and the development of Dutch natural gas exports, which by 1974 exceeded internal Dutch consumption. The success of natural gas in the Netherlands stimulated the search for gas in other countries and for supply projects. These other countries were able to successfully progress indigenous gas developments, for example the UK with North Sea production.

Two more export players joined, namely Algeria and Norway. Shell was a shareholder in the company that initiated supplies of LNG from Algeria to Europe. Shell also played an active role in developing the Norwegian gas supplies, and in transporting them to the markets of Western Europe. Major offshore pipelines had to be built for the Norwegian gas to be sold in Germany, the Netherlands, Austria, Belgium, France and Spain.

All the foregoing has led to the European gas supply system as we know it today, a system that integrates most of the countries of greater Europe not only physically but also commercially.

East Asia

The East Asian gas markets, primarily the Japanese one, are of course the outstanding examples of long distance international gas projects, particularly LNG. The LNG imports have assisted economic integration in the region by helping to smooth a potential balance of payments problem caused by rapid economic development. Shell again played a major role in creating and implementing major projects that were to supply these markets. Gas demand for power generation formed the necessary basis for securing the enormous investments in exploration, production, liquefaction, sea transport and regasification. Unlike Europe, Japan has never used much gas for space heating. This is mainly because of the warmer climate, but also because the high transport cost made it more difficult for gas to compete with kerosene and gas oil. The success of natural gas in Japan does show, however, that, where the diversification, environmental and efficiency advantages are recognised, high costs of supply need not be an insurmountable obstacle.

South America

Natural gas production in the last 20 years in South America has grown steadily. In Argentina it now fulfills more than 40% of total primary energy. In other countries, such as Venezuela, Brazil, Chile, Colombia etc., natural gas has penetrated to a somewhat lesser extent. In the early years of the industry, as was the case elsewhere in the world, consumption was initially geographically closer to supply. The foundation of indigenous production and consumption was then built on by pipeline exports from Bolivia to Argentina starting well over 20 years ago. At present this is the only larger scale international gas trade within South America and no gas is exported from the region.

2. NATURAL GAS OPPORTUNITIES IN SOUTH AMERICA

Taking into account the continent's population, natural gas markets comparable to those in Western Europe or the United States exist, at this moment, in Venezuela and Argentina only. These are also the only countries where, at the present time, natural gas is being produced in large quantities. This situation is not too dissimilar from the one in Western Europe during the early Sixties when important amounts of

natural gas were being produced in France and the Netherlands only There is one other parallel between Western Europe then and Sout America now: both had entered a phase of rapid economic development This contributes to a considerable natural gas demand potential.

The reserves of Venezuela, Argentina, Bolivia and Peru are suc that, on world standards, indigenous market requirements for gas can b amply covered while leaving major volumes of gas for export. In th case of Venezuela, the location of the country makes it more likely tha gas will be exported, at least for the foreseeable future, out of th South American region. Longer term it is conceivable that natural ga could be exported from Venezuela to other countries in South America for example as LNG.

It is not very practical to speak of a natural gas demand potentia in isolation from the supply situation. The reason, as we all know, that the cost of producing and delivering the gas to market vari enormously around the globe due to the location of reserves and distan from market. Even bearing this in mind we believe it to be entirel plausible that gas consumption will increase considerably between n and 2010. For example, even on a conservative assessment, in t Southern Cone countries of Argentina, Brazil, Chile and Peru, g consumption could double by 2010.

This estimate is based not only on the expected rapid econom development of the region, but also on the presence of important prov gas reserves. The total reserves are only slightly smaller than t total reserves of Western Europe, a region which has been much mo extensively explored.

The share of gas in the national primary energy supply illustrates point made earlier; namely that the cost of bringing gas to market is primary importance. The example of Japan ,however, shows that gas wi find its place in a strongly developing economy, even if the cost supply should be relatively high.

Along with other companies, we in Shell have recognised the futu for gas in South America at an early stage. We are involved in the ma **Cristobal Colon Project in Venezuela** for which a joint venture agreeme was signed in January 1994. Participants in this LNG project are Lago (an affiliate of PDVSA) (33%), Shell (30%), Exxon (29%) and Mitsubi (8%). The project has been granted Congressional Authorisation in Ma 1994 and a joint venture company Sucre Gas is being establish

Start-up date for an approximately 6 MTPA liquefaction plant is currently envisaged to be early next decade. Furthermore we are studying the **Camisea Project in Peru.** Here Shell is carrying out a feasibility study jointly with Petroperu in investigating ways to exploit this large gas field.

Moreover, our Operating Companies in all South American countries are considering diverse business opportunities to bring natural gas to the South American customer.

3. REGIONAL INTEGRATION BENEFITS

Common to the existing natural gas projects in the world are the enormous up-front investments required and, partly as a consequence, their large time scales. Such projects can only be undertaken if the sellers of the gas can secure guaranteed revenue for many years. In practice this means take-or-pay contracts. The buyers, on the other hand, must have the certainty that the volumes which they are committed to buy can be placed in the end user market. This implies competitive pricing at the burner tip: the end user, who is often faced with considerable investments to convert to natural gas, must be sure that he will not regret his decision, irrespective of the development of the price of the competing form of energy. It has taken some time to learn this lesson: in the early years of the gas industry Dutch gas, for example, used to be sold internationally at fixed prices, a system which proved untenable in the face of the violent oil price fluctuations in the Seventies and Eighties.

This pricing system does not eliminate risks, rather it places the price risk with the seller and the volume risk with the buyer. Experience has shown that, even if one adheres to this general principle, regular revisions of prices and contract volumes may be desirable. Although buyer and seller will naturally disagree to some extent about the gas price, it cannot be in their long term interest if that price remains consistently out of kilter. Once buyer and seller have entered into a long term agreement, they have formed a community of interests which, in practically all cases, has been shown to be remarkably strong. The seller has an automatic interest in the economic well-being, prosperity and efficient operation of the buyer and the economic area he represents. Conversely, the buyer depends on the economic and political stability in the country from where he imports his gas because he has a vested interest in the reliable and efficient operation of his gas supplies.

By its very nature then, natural gas is different from crude oil. Its low energy density results in higher transportation cost than for either crude oil or coal. Because of these factors natural gas is not a commodity sold speculatively into an unknown and unseen market and end-use. Natural gas is sold with knowledge of, and indeed close relationship with, the end-user. The two are linked for the long term by the necessary transportation system, which may in fact be operated by another party. In the case of pipeline gas, the seller does not have the ability to redirect his supply elsewhere, neither does the buyer have the ability to obtain alternative supply. Ongoing cooperation is needed between the two ends of the transport system, i.e. the seller and buyer, and with the middle, i.e. intermediate offtakers and transiters, for the lifetime of the project.

All this means that the community of interests brought about by the long-term mutual commitment of an international supply contract promotes regional integration. This is in the form of the physical integration caused by the gas transport system, the energy integration arising from exports and imports to balance supply and demand, and commercial integration through long term trading relationships to mutual benefit. Above all though there is the integration of people working together for the common good. The way this works is usually not headline grabbing, but, nonetheless is important. The history of the natural gas business world-wide shows how well-balanced deals can weather the storms of change. By way of a single example, the Cold War was at its height when Soviet supplies to Western Europe were first contemplated, and political differences continued for years during which regular supplies were made. Today those original political differences between buyer and seller are no more, but within the countries of the former USSR and transited Eastern Europe countries there are economic problems. Nonetheless the gas still flows.

4. ENVIRONMENTAL ASPECTS

Environmental concerns played hardly any role at all when Dutch natural gas was first exported to neighbouring European countries during the Sixties. However, they have always been important for the densely populated coastal strip of Southeast Honshu in Japan In more recent years environmental matters have globally become an increasingly important constituent of the value of natural gas.

A case in point is the use of natural gas for power generation in Europe. Safety concerns over nuclear power generation have risen

everywhere, leading to more expensive plant, delays in planning and construction and in many countries a complete suspension of the building of new nuclear power plant and even abandonment of existing plants. As for coal-based power generation, its viability in Europe has decreased after the removal of subsidies or closure of national subsidised coal mining industries in many European countries. In addition, emission requirements are getting ever stricter, adding to the cost of coal-based power. The use of gas for power generation, still frowned upon in Europe as recently as ten years ago, has become preferred. The chief reasons for this are the recognition of ample reserves of natural gas and the advent of new combined cycle gas turbine technology enabling high efficiency, clean and cost effective generation of electricity from natural gas.

An even more recent development is the aim to reduce emissions from automobiles. Although natural gas does not have some of the advantages of gasoline as an automotive fuel, under some circumstances its use is being promoted as a means of reducing pollution.

The relative environmental performance of the various fossil fuels regarding local, regional and global effects may be compared according to the extent of their impact. Of immediate concern are the local and regional effects of energy use because of their direct effects on the health of people, animals and vegetation. The beneficial effects of substituting natural gas for oil products or coal are quite considerable. Natural gas also is favourably benign regarding the possible greenhouse effect.

The gas that is fired in medium size steam generators in Germany is a good example of the impact of environmental legislation on the value of natural gas. Operators of existing coal-fired boilers are faced with the choice of either equipping their boiler with clean-up installations, or converting to gas, in which case no clean-up equipment is needed, provided the gas burner is of a modern, low-emission type. The cost of converting to gas is in fact much lower even though the emission limits for 50 t/h boilers are much more stringent for gas-fired boilers than for coal-fired ones. The advantage of natural gas is even more pronounced if one has to decide between a new gas-fired and a new coal-fired boiler. To arrive at the same annual cost, the operator of a gas-fired boiler can afford to pay over USD 2 per million Btu more for gas than for coal. Few countries have an environmental legislation as strict as Germany but there is a tendency for other countries to follow

their lead. However, even in the absence of such legislation there are often distinct advantages of natural gas over competing fuels, especially in the residential and commercial markets.

In summary, natural gas has been of great benefit in improving the living conditions in the population centres of Europe, Japan and North America, and it can do the same for South America if priced appropriately

5. PROVISIONS ESSENTIAL FOR GAS BUSINESS DEVELOPMENT

Integrated Gas Chain

The first and foremost of these provisions for an emerging market is, in our opinion, a reliable and secure supply: it is imperative that the seller discharges his contractual obligations as scrupulously as possible. This is not only a matter of business ethics, it is most of all plain good business. Even short supply interruptions through no fault of the supplier, i.e. where he can claim "force majeure", will harm his business. In all cases where short supply hiccups occurred, this has cost the supplier, often dearly. The reason is that the buyer will from then on begin to allow for such interruptions, for instance by onselling a larger part of his gas to interruptible customers, with lower revenues as a consequence. This automatically reflects on the value of such less reliable gas.

International natural gas projects in Europe and East Asia are usually set up according to the diagram of the appended chart. There are, of course, local variations to this theme: large countries such as Japan and Germany do not have one single national transmission company but rather a small number of geographically segregated transmission companies. In Germany there are, in addition, a large number of regional and local distribution companies.

Pipeline companies need a tariff system that makes economic sense In general each user pays a capacity charge in proportion to the maximum transport capacity he wants to reserve for himself. This should reflect the investment made as well as the fixed operating cost; it should therefore be constant in real terms over time with a small fraction indexed to the development of the fixed operating cost. The commodity charge, which is paid in proportion to the volume actually transported reflects the variable cost and the reinvestment for running equipment In addition, the user is charged in kind for the compressor fuel. The

result of such a tariff system for a typical scheme clearly demonstrates the economies of running the pipeline at a high load factor.

Compared to gas transport through European trunklines, the amounts for transportation over long distances in South America can be relatively small, certainly in the beginning for market sectors with slow build-up. This can weaken the economic viability of such projects through sub-optimum economy of scale. Larger initial volumes of gas and better economics can be secured if power generation is the end-use.

Finally, as mentioned before, an important provision for the success of large-scale gas projects is that the end user should pay a price which fully reflects the value of the gas and thereby enables the supplies to be brought forward. This value of gas is normally established by reference to the competing energy, itself often priced at world level. Selling to the end-user at such full-value price also provides the correct signal and ensures efficient consumption.

Financing

Major gas projects often need substantial external finance which in turn requires sound long term contractual arrangements between solid producing, transporting, and buying entities. Reliable operation must be assured. Risks should be limited and assessable.

Government and Fiscal Policies

A supportive attitude in all aspects (namely upstream, transportation, the market, environmental) may be required for long distance gas projects.

Partnerships

The integrated nature of gas projects means that all involved in the chain must view themselves as partners in the integrated venture. Good long term contracts are based on mutual benefit.

Project Leadership

The scale and complexity of major gas ventures, especially international projects, is such that sound and experienced project leadership is necessary to ensure success.

Other

The final provision necessary is frequently that of patience. Every gas market of the world has started with indigenous or local supply wherever possible. With the progression of time and technology, the economic viability of longer distance transportation and intra or inter

country trade has increased and such links have been developed - but always over years or even decades.

6. OUTLOOK FOR GAS DEVELOPMENT IN SOUTH AMERICA

We have so far seen that in South America there are adequate gas resources and there is a gas market. There also appears now to be a business climate conducive to the large-scale, long-term undertakings which the gas industry needs. What is required now is an infrastructure to bring it all together and sufficient initial sales volume to provide a viable start, eg by gas sales for power generation. The Venezuela reserves are well placed for export from the region. The major gas fields of Argentina, Bolivia and Peru could in theory be integrated in an infrastructure supplying a larger part of the South American continent. In Europe and Japan we have seen that the initial large infrastructural investments were justified by long term contracts for supply to power stations, large industrial consumers and in some cases gas distribution companies. The same kind of binding agreements, entered into by financially sound and operationally reliable companies, will be an essential requirement for the financing of the long gas supply chains which are now being contemplated in those South American countries where the gas business is ready for take-off.

To reiterate the main message: the gas industry can bring large benefits to the people of South America either by indigenous use, exports from the region, or by inter-region movements of gas. For the latter it is integration which is needed: all the way down from the gas fields, via the trunk lines to the end consumer. By whatever commercial structures, the production, transport and marketing have to be integrated in these large international projects, thus establishing true communities of interest. This is by no means easy. We, in Shell, are ready to contribute our experience.

International Natural Gas Project