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IN SEARCH OF A GAS GRID:

A NATURAL-GAS PIPELINE SYSTEM FOR JAPAN

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Energy

In search of a gas grid

Japan's gas use is set to increase dramatically, particularly if growing public opposition makes building new nuclear plants impossible. But in order to benefit from new sources of gas in the region, the country first needs a gas grid

While Japan hatches plans to import gas by pipeline from Sakhalin or the Asian mainland, it has a fundamental problem — when the gas arrives at Japan's coast there is, as yet, no infrastructure to receive and market it throughout the country's four main islands. Japan may be the world's seventh largest natural gas user, just below Canada and above Italy, but it is unique among major consuming nations in its lack of domestic transmission or distribution pipelines. This peculiarity is a key reason for Japan's exceptionally high retail energy prices, which are a serious burden to the competitiveness of it's industry. As Japan formulates its energy strategy for the 21st century, there is a growing consensus that this is a problem which has to be solved.

The 62 billion cubic metres (2.2 trillion cubic feet) of gas that Japan consumed in 1997 amounted to 12 percent of total primary energy, and consisted mostly of LNG imported for electricity generation. LNG powered more than 25 percent of Japan's electric production, while nine power companies consumed just over 50 percent of total gas supply. However, the manufacturing, commercial and residential uses of natural gas remain very low in contrast to other high-income countries, both per-capita and as a share of total energy.

Domestic production accounts for only three percent of gas supply, while LNG is landed at 20 widely-dispersed marine terminals. These terminals are sited primarily to supply power stations, and are connected only erratically with the city gas utilities that serve factories, commercial establishments, and homes. As a chain of mountainous islands whose territory lies entirely within 100 miles of tidewater, Japan has nevertheless got along tolerably well until recently with an energy strategy that relied upon ocean transport for a clean-burning electrical generation fuel and avoided the need for laying a costly pipeline grid throughout its densely occupied and earthquake-plagued terrain.

But there is now a feeling that things have to change. The Japan National Pipeline Research Society, whose 44 corporate members include Japan's biggest gas and electric companies, such as Tokyo Gas, Tokyo Electric, and Osaka Gas, its principal industrial and commercial energy buyers and the manufacturers of heavy capital goods for the energy industries, such as Nippon Steel, plus seven government agencies, has now concluded that the lack of a trunkline network is a key block to the further expansion of natural gas use. Japan needs to increase its gas use for its long-term energy security, to lower the country's carbon dioxide emissions and to mitigate its high energy prices — the highest of the world's top industrial nations.

Only 5.4 percent of Japan's urbanised area is served by a gas distribution system. Even the three largest city gas utilities, based in Tokyo, Osaka, and Nagoya respectively, with 15 million total customers, have distribution mains that extend at most 50 kilometres from an LNG terminal or synthetic gas plant. The outlying service areas of the big city utilities and the 200-or-so much smaller city gas companies depend on truckload shipments of LNG or, even more frequently, LPG in bottles.

The absence of national or regional transmission networks thus dooms even large industrial companies in the major coastal load centres to dependence on overseas and domestic supplies of comparatively high-cost fuels, delivered inefficiently by regional and local monopoly vendors. It precludes optimal siting and benefits from economies of scale in the operation of terminals, synthetic gas plants and storage. Japan is also deprived of the ability that Europe and America have to level demand by shifting deliveries seasonally between northerly winter-peaking and southerly summer-peaking markets, and between "high priority" spaceheating and process-fuel users and oil or coal-capable "interruptible" customers. Nor is Japan able to use "line pack" (the expansion and compression of thousands of kilometres of gas in transit) to meet

Forecast Asia-Pacific LNG demand (million tonnes)					
	1995	2000	2005	2010	2015
Japan	45.0	51.0	60.0	67.0	73.0
South Korea	7.1	14.4	17.6	21.1	25.2
Taiwan	2.9	7.1	9.9	13.5	17.1
India			7.1	9.4	11.7
China			2.5	7.6	12.9
Thailand				2.5	5.0
Total	**55.0**	**72.5**	**97.1**	**121.0**	**144.9**
Source: Wood Mackenzie					

short-term load fluctuations and thus maintain delivery pressure and supply reliability.

Landed costs of LNG, even at world market prices, are then inflated by physically inefficient and monopolistic distribution arrangements, meaning that prices for Japanese end-users are three to five times higher than those in the USA or the UK, and more than twice those in other import-dependent countries such as Germany or France. The disparities are narrowest for electricity generation, because gas-fired power stations are typically sited adjacent to a marine terminal and because the electric utilities, alone among gas consumers, are able to purchase LNG at world market prices rather than from a local gas-company monopoly.

Entrenched suppliers

The electric companies themselves are vertically-integrated regional monopolies loaded with excess capacity and excess costs. Although new government regulations permit the construction of non-utility power plants, effective competition from IPPs and industrial self-generation or cogeneration in Japan depends on the establishment of a gas transmission grid that will offer alternative power producers open access to the only environmentally acceptable generation fuel at a competitive price, plus a real choice among potential plant sites.

High energy costs are a persistent burden on Japan's stagnating manufacturing sector, but small consumers are at the greatest relative disadvantage. Despite winter climates comparable to those of the Northeastern US or northwestern Europe, retail gas rates of $30-35 per million btu leave most Japanese homes (which also are typically lacking in insulation) without central heating and often without spaceheating of any sort.

According to Hikaru Yamada and Dr Kengo Asakura of the Mitsubishi Research Institute, in a recent report for the pipeline research society, Japan has four serious structural problems in the energy industries.

To solve these will require a revolution from above comparable to the Meiji "Renovation" of the mid-19th Century, in which a government of feudal reactionaries introduced liberal capitalist reforms in order to spare the nation military and diplomatic humiliation by the Western imperial powers. The authors comment:

Needing a Meiji

* "First, a paramount cause of Japan's economic downturn and its continuing stagnation is the structural high cost of energy, derived from an obsolete mix of primary inputs, compounded by inefficient marketing arrangements and the absence of competitive pressures for reform and restructuring."

* "Second, Japan faces a severe energy crisis in the 21st Century, to the extent that it is physically unable to accept, distribute, and absorb significant additional gas volumes either as LNG or by pipeline from Sakhalin and the Asian mainland." Yamada fears that Japan will miss the opportunity "to participate in procurement of secure, long-term resource supplies from

northeastern Russia, especially in the face of rival demands from the explosive economic growth of neighbouring China."

Furthermore, "government and industry projections have not adjusted to the coming growth in demand for natural gas resulting from its cost advantage relative to other fuels, and because it offers the only acceptable means of accommodating the growing public opposition to nuclear reactors."

* "Third, Japan will incur serious additional environmental degradation, especially in the form of acid rain and dioxin poisoning, a grave situation arising in the incineration of solid waste, which is thus far insufficiently recognised at home or abroad". This situation, according to Yamada, "calls for expansion of direct gas use and installation of new waste destruction systems capable of disposing of the resultant clean, high-btu gaseous fuel through the general gas-distribution network."

High energy costs

* "Fourth, high energy costs, security of primary supplies, efficient fuel distribution and waste disposal, all require a new supply structure centering on a domestic gas-transport web, and reforming the monopoly structure of Japan's energy industries.

* "Finally, in order to avoid a multi-trillion yen government bailout of assets that will become distressed as a result of competitive restructuring, the big gas and electric utilities must immediately unbundle their functions; initiate, and participate in establishing competitive market structures; and thus generate sufficient profit during the transition to write down the otherwise stranded costs associated with excess capacity and obsolete plant accumulated over the past decades."

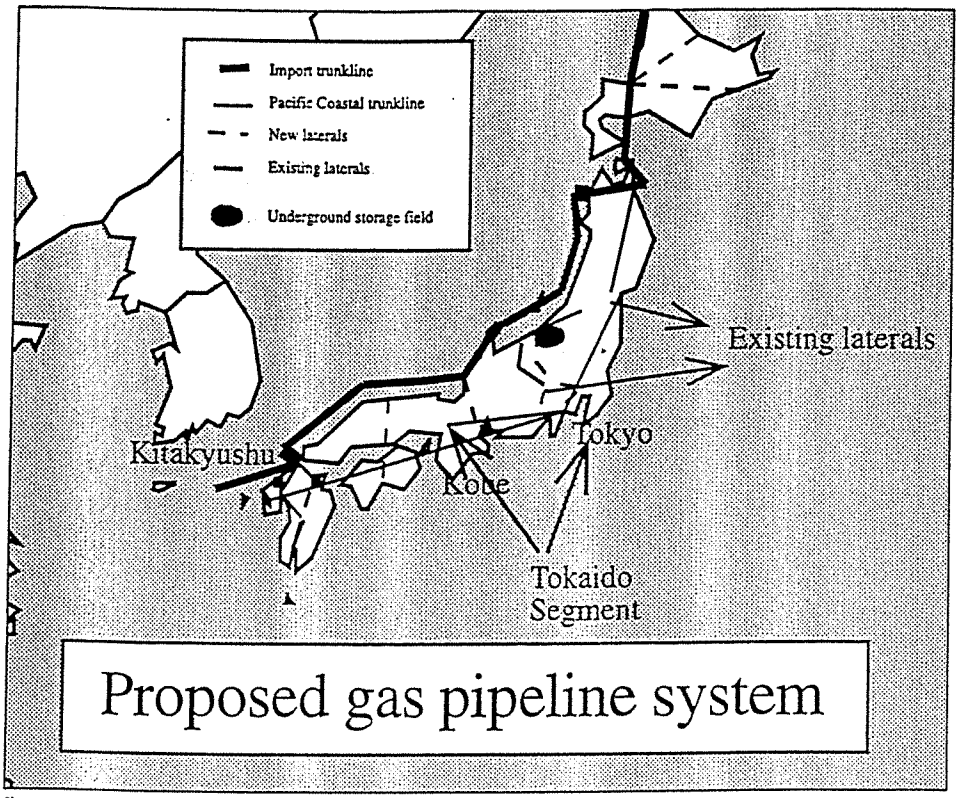
The Japan National Pipeline Research Society, which was established under tacit government sponsorship by Dr Masaru Hirata at the Mitsubishi Research

LNG terminals in Japan

Owner	Location	Storage Capacity (000 kl)
Japan Sea LNG	Niigata	520
Sendai City Gas	Sendai	n/a
Tokyo Electric & Tokyo Gas	Negishi	680
Tokyo Electric & Tokyo Gas	Sodegaura	2,520
Tokyo Electric	Higashi Ogishima	540
Tokyo Electric	Futtsu	610
Tokyo Gas	Ogishima	uc
Chubu Electric & Toho Gas	Chita	300
Chita LNG	Chita	480
Chubu Electric & Toho Gas	Yokkaichi	400
Chubu Electric	Kawagoe	n/a
Toho Gas	Minami-goku	uc
Osaka Gas	Izumi #1	180
Osaka Gas	Izumi #2	1,1258
Kansai Electric & Osaka Gas	Himeji	1,080
Kitakyushu LNG	Tobata	480
Chugoku Electric	Yanai	320
Hiroshima Gas	Hatsukaishi	n/a
Kyushu Electric	Oita	240
Seibu Gas	Fukuoka	150
Nihon Gas	Kagoshima	n/a
Total	**more than**	**9,625**

n/a = not available
uc = under construction

Source: Gasu Jigyo Biran (Gas Industry Annual)



Institute in July 1989, initially concentrated on the feasibility and routing of pipelines that could supply Japan with natural gas from Siberia, the Russian Far East and other onshore Asian sources and, at the same time, provide markets for Japanese steel, machinery, engineering and financial services. By the end of 1991, however, it became apparent that in order for Japan to receive and absorb large quantities of pipeline gas from Asia, an internal transmission system was indispensable. The society at that time defined the essential conceptual elements of the proposed system as *(see map above)*:

* a 2,500 kilometre Pacific Coastal Marketing-Distribution Trunkline, linking the biggest urban centres on Honshu (Tokyo-Yokohama, Nagoya, Kyoto-Osaka-Kobe, and Hiroshima) with each other and the existing LNG terminals;

* a parallel, 2,500 kilometre Import Trunkline, which would extend along the Japan Sea Coast facing Asia, from the Northern Hokkaido landfall of an undersea Sakhalin pipeline to a connection with the Pacific Coastal line near Kitakyushu, at the Japanese intake point for the Trans-Asian pipeline from Siberia or Central Asia; and

* a number of 200-300 kilometre Lateral Support Lines crossing Honshu, interconnecting the two mains, and providing supply to intermediate markets.

The initial, most critical piece of this plan would be the 500 kilometre, 40-inch Tokaido segment of the Pacific Coastal line between Tokyo and Kobe, a region that accounts for 80 percent of Japan's total energy consumption. A June 1997

Average delivered gas prices by sector 1996 (US$ per million Btu)

	Electrical generation	End-use sector Manufacturing	Residential
United States	$2.64	$3.28	$6.17
United Kingdom	$2.94	$2.37	$8.28
France	n/a	$4.18	$11.98
Japan	$4.30	$10.93	$32.99

Source: OECD Energy Prices 1997

incremental cost of 300 billion yen (about $2.5 billion) to lay this pipeline under the Second Tomei-Meishin Highway, now under construction, and a new belt highway planned to circle Tokyo.

Private finance needed

Until recently, participants in the investigation took it for granted that the Japanese government would organise, finance and operate the internal gas-transmission system as a sequence of public works projects, on the historical pattern of the post office, national railroads, and telephone system. But chronic government weakness and expenditure cutbacks in Japan, together with the global tide of privatisation and deregulation, have left this strategy increasingly implausible and unattractive. Project organisers now advocate private construction, financing, and ownership of an open-access pipeline system, with the government's role limited to capital contributions or loan guarantees, granted in recognition of the public gains to be generated by the project in the form of cheaper fuel, environmental benefits, and energy security.

As of early 1998, the pipeline study society will become an organising committee for a private consortium to implement the first stage, which its adherents hope, will break precedent by including active foreign participation in up to one-third of the required investment. One oil and gas major and one US utility conglomerate are already actively discussing joining the consortium, bring the project one step closer to realisation. **Arlon Tussing**

Algeria's Big South

While the civil war raging in Algeria is causing a few diplomatic problems, the stark reality is that Algeria's oil and gas reserves are far too important for Europe's future energy needs for investment not to continue

Algeria is two countries. There is the northern coastal strip characterised by cities, hills, valleys — and war. Then there is the country the Algerians call the Big South, the vast desert interior characterised by rock and sand — and oil and gas. The revenues from the latter help the government maintain its position in the former. So far, at least, the civil strife in the coastal zone has barely threatened the development of Saharan hydrocarbons.

Yet the issue remains alive. Last November, a fire damaged two valves some 20km from the Tunisian border on the TransMediterranean pipeline which carries Algerian gas to Italy. The incident, which briefly disrupted gas flows, appeared to be an act of sabotage by the government's Islamist opponents, though no formal claim of responsibility was ever made.

It was incident that illustrates both the strengths and weaknesses of Algeria's hydrocarbon industry and export systems. The weaknesses are obvious; long stretches of exposed pipe, particularly in the case of the TransMed line, built in the late 1970s, long before the civil war which has dominated the 1990s. The strengths include the remnants of social cohesion in Algeria: in general the country's oil and gas installations, which provide Algerian workers and their extended families with much of their basic income, are not targetted by the Islamist militias. But the principal asset remains the region's isolation. The main oil and gas fields at El Oued, Laghouat, Illizi and Ouargla are located in four exclusion zones created by the government in April 1995 to safeguard key production facilities.

An extraordinary combination of security forces operate in and around these areas. The army and police regulate traffic and shipments within these security zones; militia forces hired by Sonatrach, the Algerian state hydrocarbons giant, police production facilities, pipelines and export terminals; private security concerns such as Executive Outcomes, technically operate at key installations as advisers but are generally assumed to be capable of performing operational activities, as well as training the local security militias. Throughout the region, an array of high-tech equipment ranging from ground radar to satellite