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For our first debate in this issue we have turned our sights towards Japan, to which for too long we have given little specific attention. Our first paper is provided by Tsutomu Toichi and Masahisa Naitoh. Energy supply security has always been a prime objective for Japan, but to that have been added more recently economic restructuring to deal with the problem of cost and Kyoto targets to respond to environmental demands. They point to the success that deregulation has already had in market prices for gasoline and the massive switch from oil to LNG which has greatly diversified supply sources. The strategy for oil has been altered so that JNOC is now more likely to enter into joint operations with other companies, although the objective of gaining access to Middle East oil remains. Further deregulation of gas and electricity is needed, but this pre-supposes an internal pipeline network for market distribution.

Lindsay Fairhead and Karen Schneider accept that energy security has been greatly improved by diversification of the range and sources of fuels and by energy efficiency and conservation measures; this has included not only a switch to gas, but also coal and nuclear. But, they point out, this has been at the expense of cost and service. Deregulation and increase in competition will be the motors for future development and they look at the 'New Action plan for new economic growth' published last November as the key document. ABARE studies show that Japanese success in deregulating non-energy markets will be as important for energy security as direct energy market reforms. Although expansion in the services sector may lead to an

increase in energy demand, nevertheless the energy intensity of the economy should decline.

Samuel Van Vactor also deals with the main thrust of Japanese energy policy, the search for diversification of fuel supply and the problem of high cost. He points out the difficulty Japan will have meeting Kyoto guidelines now that energy demand is concentrated more in the commercial and residential sectors than in industry. Nuclear diversification is now, as it is elsewhere, open to continuing safety concerns. While deregulation is essential for increasing competition and reducing cost, he sees the development of an internal gas grid as the determining factor in the Japanese effort to reduce costs towards an internationally

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Other factors will of course be operating at the same time as regulatory reforms that will also influence the energy sector. Regulatory reforms in the energy sector itself, for example, will act to increase energy demand even further in response to lower energy prices, while climate change response policies are likely to have a dampening effect on energy consumption. The important factor is that policies in all sectors of the economy, and the interactions between those policies, will have at least as important an impact on energy security outcomes as direct energy policies.

The above analysis is based on ABARE's forthcoming report 'Japan's Energy Future: Alternative Scenarios'.



Will the snow tiger come down from the mountain wonders Samuel Van Vactor?

Japan has been Asia's leading economic tiger, but in the past decade its economy has sputtered and its high-growth neighbours may soon challenge its preeminent position. Consequently, Japan's energy policy must be viewed in the context of a broader industrial strategy and is apt to change abruptly. The island nation has three fundamental objectives that are not always consistent with one another: Japan seeks to enhance energy security and reduce its vulnerability to energy shocks; it has agreed to reduce its emission of greenhouse gasses by 6 per cent; and it would like to liberalise its energy markets in order to lower consumer prices and make its industry more competitive.

Unlike another island nation, the UK, Japan does not have known oil and gas fields in its surrounding seas. Apart from high-cost coal and a comprehensive nuclear power programme, it has virtually no domestic energy supplies, which leaves it particularly vulnerable to oil shocks. Rapid economic growth since the end of the Second World War, combined with a high population density, has also impeded the development of electricity and natural gas transmission and distribution grids. It is costly to move energy around in Japan and this constrains the competitiveness of its manufacturing industry.

Japan continues to emphasise its nuclear programme, while most of the world is going in a different direction. The penetration of natural gas pipeline networks throughout Europe, Southeast Asia, South America, and North America is increasingly regarded as the framework for a twenty-first century energy delivery system. This arrangement allows the low cost distribution of methane, natural gas, and perhaps eventually methane-hydrogen mixes. These fuels, in turn, can be used to power distributed energy systems that promise to be inexpensive and virtually non-polluting. Japan, in contrast, has made little or no progress in the creation of a gas pipeline grid and similar infrastructure, which contributes to its dependence on costly and inflexible central station coal and nuclear power generators. The country's fragmented energy delivery infrastructure also raises fundamental questions about the potential success of market liberalisation. Without dispersed ownership and a robust and flexible energy infrastructure, liberalisation is unlikely to lead to lower prices, but instead will probably concentrate the industry further, making reform all the more difficult.

Energy Security

Energy policy in Japan is driven by one overriding fact: the country has limited resources and a modern industrial economy, requiring vast amounts of imported energy in the

form of oil and liquefied natural gas (LNG). The dependence on imports spawns a level of vulnerability unique among the world's developed nations. At the same time, however, the leaders of all the major economies now recognise that oil shocks similar to those in 1973, 1979 and 1990 harm everyone by disrupting trade and provoking worldwide recessions. Thus, Japan is not alone in its concern for energy security and stability.

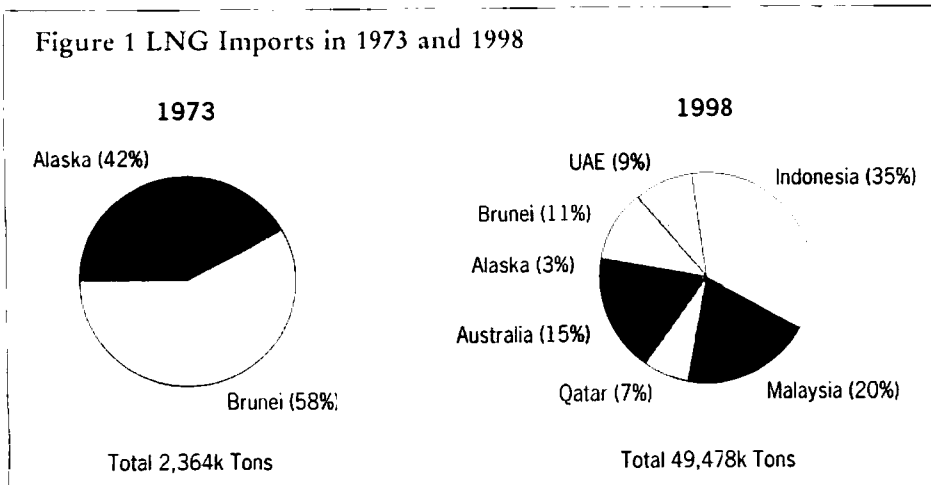
Japanese policy hoped to mitigate the vulnerability that arises from a disproportionate dependence on imported oil and gas, via (a) diversification of supply sources; (b) participation in the International Energy Agency (IEA), in which members pledge to share oil in an emergency; (c) stockpiling.

The policy of oil supply diversification is not new. Japan always purchased crude oil from a variety of countries. There is, however, the inevitable tension between commercial interests – getting the best price – and maintaining strict rules of diversification. In this respect the results of the last quarter century are interesting: Japan's dependence on Middle East oil has actually increased from 81 per cent in 1973 to 91 per cent in 1998, mainly reflecting a drop in imports from Indonesia.

On the other hand, LNG sources are well diversified and offset much of this increased dependence on Middle Eastern oil. In 1970 Japan received LNG from only one source – Alaska's Cook Inlet. Volumes then were very low, just shy of one million metric tons. By 1998 Japan had built 23 domestic terminals, and the country now receives nearly 50 million tons of LNG annually from eight different countries, primarily Indonesia.

Japan's initiative to stockpile crude oil and petroleum products also contributes significantly to energy security, particularly in mitigating the impact of short-term shocks. In 1973 Japan's petroleum stockpile was good for only 57 days. By the time of the Gulf War, in 1990, it had 142 days supply. This came about by adding to physical inventories and by switching

Figure 1 LNG Imports in 1973 and 1998



much consumption (particularly power generation) to natural gas. In 1973, Japan, whose GDP had grown by 9.1 per cent in the prior year, was highly vulnerable to the oil shocks. As the shock spread through the industrial world Japan's economy nose-dived, with growth falling to 5.1 per cent in 1973, followed by a recession in 1974. The 1979-80 oil shock, in contrast, had a far less severe impact on its economy and did not provoke a recession. Figure 2 illustrates the relationship between the oil shocks and the growth in Japan's economic output. Until the first oil shock, imported energy cost the economy approximately 1.5 per cent of its annual GDP. With the oil price increase of 1973 the proportion of GDP devoted to energy imports rose to over 4 per cent; with the 1979-80 crisis, the proportion increased again, peaking at 5.4 per cent.

The collapse of crude oil prices in 1986 pushed Japan's cost of imported energy back down to earlier levels, and may have provoked the 'bubble economy' of the late 1980s. By the time of the Gulf War in 1990-91, energy by itself was not a major contributor to the economic downturn. Instead, the US recession and the high cost of doing business in Japan meant that during the 1990s there was virtually no economic growth (other than in one year, 1995) while the United States and Japan's neighbours in Northeast Asia saw unprecedented spurts of economic prosperity. This has led many critics to suggest that the chief impediments

to its economic progress are the barriers to competition in so many sectors of its economy, giving rise to the third and most recent pillar of Japan's energy policy - market liberalisation.

Reducing Greenhouse Gases

By luck or design, the first major agreement among nations to reduce CO₂ and other greenhouse-gas emissions was negotiated at the UN Kyoto Conference in December 1997. The venue, combined with increasing public concern, means that the target - to reduce greenhouse gases by 6 per cent by 2010 - is taken seriously. In addition, the decision process in Japan is more centralised than in countries like the United States so that companies and individuals are likely to be more responsive to the government's goals.

Achieving the goal is not, however,

going to be easy. Energy demand growth in Japan is no longer centred in industry, but rather in the commercial and residential sector. Energy consumption in these sectors is harder to direct than in the industrial sector since use is spread among a wide range of individuals, not concentrated in a few large industrial complexes. (The stock of motor vehicles, for example, has increased from 23 million in 1973 to 58 million in 1998). In a democracy, consumers are ultimately vested with the bulk of political power, which makes it difficult to implement harsh measures with little obvious benefit on a personal level. In addition, some of the most promising policy options for reducing greenhouse gases, such as emission-trading rights, are not directly applicable to the residential and small commercial sector. Figure 3 illustrates the historical trend of energy-related CO₂ emissions. Until 1973, most emissions growth came from the industrial sector, but since then individual consumers have most actively added to greenhouse gas emissions.

Energy Market Liberalisation

The World Bank and development experts have long recognised that energy infrastructure is a necessary component of economic development. Without electricity and reasonably priced fuels, an economy simply cannot modernise. So it is with the world's front-rank economies. Energy must be plentiful and cheap if

Figure 2 The Cost of Imported Energy as a Percentage of GDP Compared to Japan's Annual Rate of Economic Growth

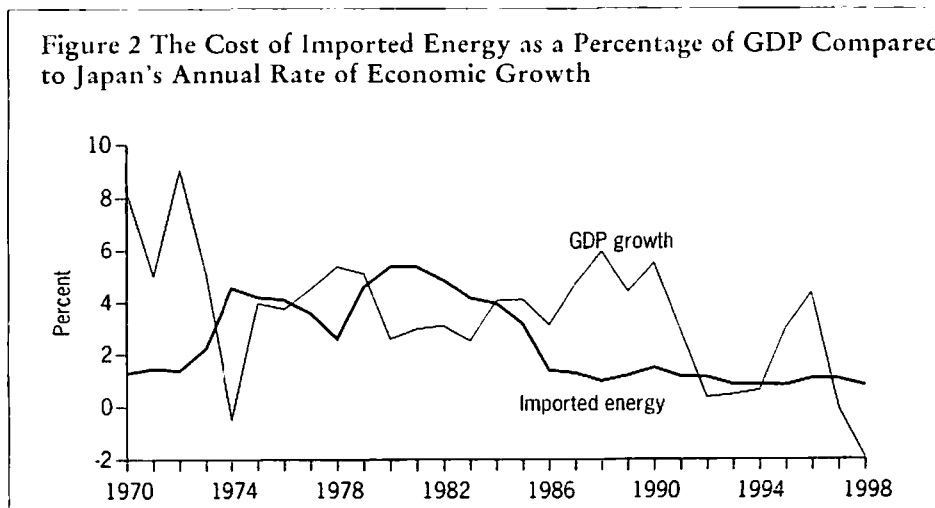
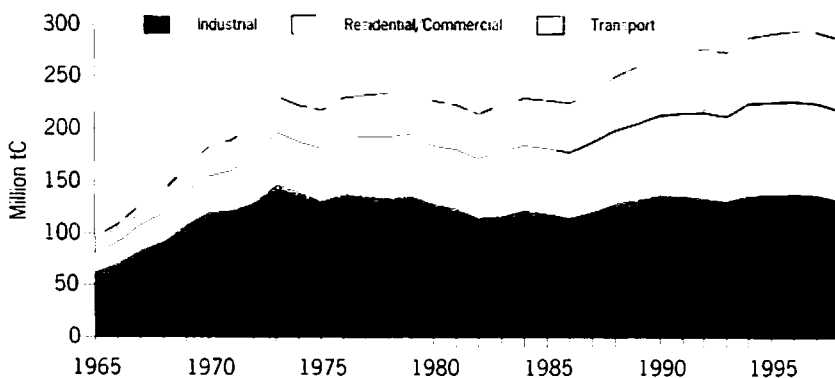


Figure 3 Japan's CO₂ Emissions by End-Use Sector



industry is to be competitive. Thus, the worldwide shift that encourages market liberalisation and the elimination of excessive regulation is as much a practical as an ideological issue. Japan has been slower than many other countries in liberalising its energy markets, which may be one of the reasons why its economic development has lagged behind other developed countries in the last decade.

Between 1996 and early 1999, Japan implemented a series of new laws and regulations aimed at opening its petroleum market. The changes made it easier for new entrants to import, distribute, and market products. The results were spectacular. For example, retail gasoline prices ex tax fell 36 per cent by January 2000. As MITI noted, 'Deregulation proved quite effective as newcomers ... began retailing petroleum products. In addition, fierce competition in the market is quickly revising the unique price structure of petroleum products in Japan to conform with international pricing structure.'

Liberalisation of the electricity sector began modestly in 1996 with a series of bids by independent producers to supply wholesale power. The success of petroleum deregulation, combined with the worldwide trend of liberalising gas and power markets, led to a 1999 plan to liberalise part of the retail electricity industry. Unlike California, however, it only applied to large customers, presumably sophisticated enough to manage the price volatility that is characteristic of all power markets. It is too early to

tell whether or not the Japanese liberalisation will be successful in lowering prices for large customers. The odds, however, may not be favourable, given that Japan's current transmission infrastructure is costly and has inadequate capacity to facilitate large-scale trading.

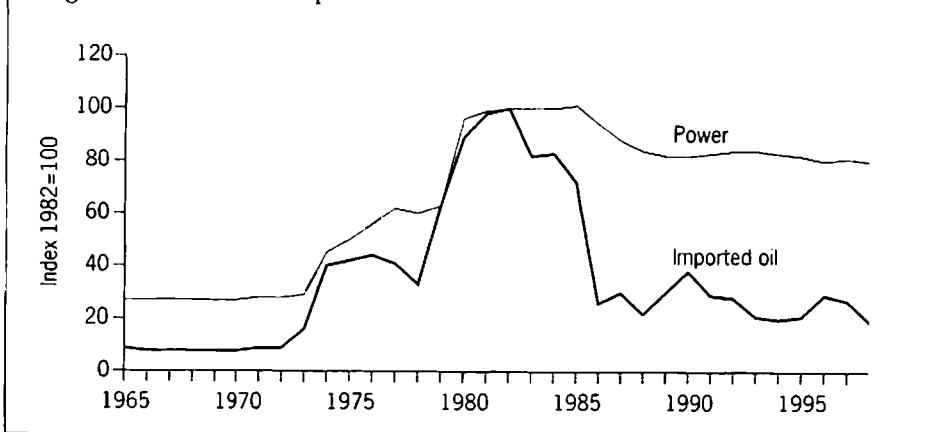
Figure 4 illustrates the relative prices of retail electricity and imported oil. The pattern is similar to the experience of many regulated industries in North America and Europe. When oil prices exploded in 1973 and 1979 they pulled up (with a lag) the retail prices of regulated gas and electric markets. However, when oil prices collapsed, the drop in regulated prices was modest at best. In Japan there were two reasons for the stickiness of retail electricity prices. First, is simply regulatory lag – the gremlin abiding in almost all regulatory procedures. Second, Japan embarked on one of the most

ambitious programmes in the world to construct and operate nuclear power stations.

On the plus side, the substitution of nuclear power for oil and coal substantially reduces air pollutants and greenhouse gases – contributing to Japan's environmental goals. On the negative side, there are questions about cost and considerable public anxiety about safety. This anxiety was heightened in September 1999, due to an accident at a uranium processing plant in Tokaimura, which killed one worker and seriously injured two others. Since then, Japan has reinforced its emphasis on safety, but this too has a trade-off with respect to cost. There are also plans to expand the programme to include breeder reactors. These thermal units would enhance security by manufacturing nuclear fuel, but they are still experimental and there are a host of unanswered questions related to their safety. Moreover, they are unlikely to prove economic even in Japan's high-cost environment. In the meantime, retail electricity prices for commercial and residential customers remain some of the highest in world, with the cost of lighting at around 20¢ per kWh.

Gas prices parallel power prices, with the retail rate to industry over \$11 and the price for town gas to homes as high as \$30 per million Btu. These prices are more than three times higher than those in Europe and four times that of the USA, at least until the 2001 price spike. The high retail prices are not due to the high cost of

Figure 4 Indexes of Imported Oil and Domestic Power Prices



imported LNG, whose average landed price in 1999 was just slightly above \$3 per million Btu – almost identical to the average wholesale price of natural gas to US local distribution companies. Rather, it is the markup involved in operating an antiquated and monopolistic distribution system. Japan has 23 LNG terminals, but there is neither interconnection (with the exception of one or two small connecting pipelines) nor competition between the systems.

“Japan embarked on one of the most ambitious programmes in the world to construct and operate nuclear power stations”

A national grid would reduce costs through scale economies and by better balancing of seasonal loads and storage. It could also be connected to gas fields in Sakhalin Island just north of Hokkaido and even to mainland Asia. Advocates of a nationwide pipeline grid have, however, been stymied in their appeals. The reason given for not constructing the pipeline system is its cost. Japan’s government has no right of ‘eminent domain’, and since it is a densely populated island nation with powerful landowner interests it is very difficult to obtain rights-of-way. It should be pointed out, however, that a pipeline system is much safer than tanker trucks or rail cars and has less of an impact on the environment than overhead transmission lines. Thus, it is unclear why Japan lags in gas pipeline development.

The collapse of the California power market ‘deregulation’ scheme and volatile gas prices in the USA, have demonstrated again that market liberalisation is not a guaranteed means of reducing energy prices. Although it has worked very well in the US gas market generally since the mid-1980s, and in the California power market until May 2000, last summer saw an unexpected downturn

in hydroelectric supplies in the Western USA, which necessitated a corresponding increase in gas-fired generation. When the resulting increase in demand stretched the infrastructure to its limit, wholesale gas prices in California peaked at unheard of levels and electricity prices now rival those in the Japanese retail market.

Japan faces similar problems in liberalising its electricity and gas markets. The basic infrastructure – the grid, combined with the location and ownership of key facilities – makes the emergence of a competitive market suspect. Policy makers would be better off emphasising the expansion of the key energy infrastructure – even its over-expansion – if they want to foster a truly competitive market. Competition requires a diversity of agents and a diversity of production, transmission, and consumption options in order to thrive.

There is an even more important reason to move ahead with a national gas pipeline grid. Like most developed countries in the 1970s, Japan assumed that some sort of nuclear technology would provide the ultimate substitute for depleting resources of oil and gas. The problem with the technology is that it works most efficiently generating electricity in large centrally located thermal stations. This requires the energy to be delivered through a transmission and distribution system of electricity wires. Even if it is established that nuclear power is ultimately the cheapest and best solution for harnessing raw energy, it is unproven that the centralised generation of electricity and transmission by wires is the least-cost alternative for delivering it.

In the last quarter century there have been significant advances in a host of technologies that are likely to be cost-effective on a much smaller scale than nuclear power. At the moment fuel cells appear to be the most promising. A fuel cell is capable of transforming hydrocarbons or hydrogen directly to electricity, without emitting greenhouse gases or other pollutants. But for the localised production of power and heat, there needs to be a

pipeline delivery system. This futuristic view has been combined with the practical development of natural gas supplies. Since the OPEC revolution, natural gas has proved to be the most abundant and cost-effective hydrocarbon available, and has largely filled the gap between growing demand and constrained oil supplies. The availability of gas from Russia, Norway and North Africa has allowed Europe to develop a system of natural gas transmission and distribution pipelines that is beginning to rival North America’s. At the same time, technologies like fuel cells and microturbines are in advanced stages of research and development so that the pipeline system might be even more efficiently utilised.

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Asia’s snow tiger is a reclusive animal. It prefers high mountains and the sparse, frozen land in the far north. Nonetheless, it is a fiercely competitive beast. Once loose, it could be a symbol for the reemergence of Japan’s economic prowess. But the tiger may stay in hiding. It would indeed be ironic if Japan’s energy policy – crafted in a period of oil disruptions and blossoming nuclear technologies – should prove to be permanently inefficient, costly, and an inhibition to its future economic development and progress.