

ENERGY INVESTMENT ADVISORY SERIES

No. 2

Investment Opportunities in Indochina's Energy Sector

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Program on Resources: Energy and Minerals
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Program on Resources: Energy and Minerals
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I. Introduction

Both Cambodia and Vietnam have applied for membership in the Association of Southeast Asian Nations (ASEAN). So far, ASEAN's six members—Thailand, Malaysia, Singapore, Indonesia, Brunei, and the Philippines—have delayed consideration of the applications, because of the current state of economic and political development in the two nations. It is likely that both countries will eventually be allowed to join the group—and possibly sooner rather than later. When this takes place, each will have access to ASEAN's rapidly progressing economic and political integration, a condition that might create new economic opportunities. Regional gas and electricity supply networks are evolving in the ASEAN states. If development continues in Vietnam and Cambodia, each country might eventually become part of these systems, though at this point it is difficult to say whether their status would be that of a net supplier or buyer from such networks. The position would depend on future hydrocarbon discoveries and developments. Laos's electricity system is already integrated with Thailand's and thereby with ASEAN.

II. The Business Environment in Indochina

The three nations of Indochina want foreign investment and trade. The people and government of each nation realize that their economies have been left backward and their citizens poor by the protracted series of wars and internal conflicts that have characterized their area. This realization is emphasized to them by the relative economic success of neighboring territories such as the ASEAN states, Hong Kong, Taiwan, and even China, which have enjoyed economic and social progress while Indochina has remained isolated by the international embargoes that followed the Vietnam War. Each nation realizes that it has a good deal to learn before it can copy the success of such neighbors. The three countries also know that they have the important advantage of being able to provide relatively low cost labor at a location that is near to these centers of growth. Given the

backward communications and transportation networks, Indochina is not necessarily low cost in areas other than labor.

Oil and gas exploration has been carried out in each nation of Indochina, though commercial quantities have been confirmed only in Vietnam. There has been much speculation that the Spratly Islands near Vietnam offer some of the more promising offshore oil exploration territory in the world. While such claims might be overstated, the islands are subject to continuing territorial disputes among China, Taiwan, Vietnam, the Philippines, and others. Each party has attempted to reinforce its claims through the establishment of military bases on the minute islands, and several have offered oil leases at least on the fringes of the area. Vietnam has generally argued that its position is supported by international agreements regarding offshore territories and has been willing to subject its claims to negotiation, provided its title to its continental shelf is not rejected. The territorial debates over the Spratly Islands do affect the validity of some leases that Vietnam has issued to international oil companies. The offshore boundary between Cambodia and Vietnam is also an area of some hydrocarbon promise and unresolved territorial dispute.

Both Vietnam and Laos have coal deposits that have attracted commercial exploration and development, though neither has the preferred steam coal variety, bituminous, in large quantities. In Vietnam, most of the coal is anthracite while in Laos it is lignite.

The Mekong River, with its numerous tributaries, is the principal river of the region, but there are other sizable river systems, notably in northern and central Vietnam. These rivers are believed to have considerable potential for irrigation, transportation, and hydroelectric generation. Cooperation in the development of the Mekong River has been a long sought if ephemeral goal. The potential for hydroelectric development is limited by seasonal flow variations, by recurrent droughts, by watershed loss due to lumbering and deforestation, and by reluctance to inundate valuable agricultural lands.

III. Investment Opportunities in Indochina

1. Cambodia

General: Cambodia is barely a consumer of commercial energy. It is thus an "open" market for any party that might wish to supply the energy-starved domestic market. Suppliers would, however, have to work with the government to find sources of funding, including the means of recovering any foreign exchange that they expend.

Oil: Cambodia, like its neighbors in Indochina, is underexplored for oil and gas. Developments in Cambodia have been handicapped by continued political instability and by civil and military insecurity. Nevertheless, exploration has continued. One firm, Premier Consolidated Oilfields, plugged and abandoned a well that tested at 1,180 barrels per day (b/d) of oil and 1.3 million cubic feet of gas per day. Another company, Enterprise Oil (UK), has claimed a well off Cambodia's south coast that yielded 4.7 million cubic feet per day of natural gas and 180 b/d of oil. Subsequent finds have also been announced. Such claims demonstrate the presence of hydrocarbons, but perhaps not yet at profitable levels. It would be a matter of interest to determine the extents to how much decisions to abandon sites were based, respectively, on geologic potential, on the difficulty of exporting any discovered reserves, and on Cambodia's continued internal disorders.

Oil consumption is estimated at 180,000 tonnes/year (about 3,600 b/d). This amount is probably supplemented by private imports from Thailand and Singapore. This volume is insignificant and could not support a domestic refining industry.

Gas: Cambodia has no natural gas production at present. Cambodia of course hopes that the increasing interest in hydrocarbon exploration will lead to the discovery of commercial quantities of gas. If commercial volumes are found, Cambodia would face a dilemma in determining whether the gas would be exported or consumed domestically. Foreign explorers would prefer the hard cash derived from exports; Cambodia, when faced with the costs of exploiting the gas, might likewise prefer the foreign exchange.

Nearby Thailand currently would willingly consume any energy produced in the region, and at some distant time Vietnam might be willing to import energy from Cambodia as well. Expensive development would be required to make any discovered gas available to such neighboring markets.

Hydro: Cambodia has long been part of the evolving Mekong River projects that have sought to develop the river's energy and irrigation potential. The projects have been interrupted by war and politics but seem to be reviving.

Renewables: In 1993 Cambodia consumed 200,400 cubic meters of firewood and 10,600 tonnes of charcoal. These numbers are down considerably from peaks in 1969 before Cambodia was drawn into the Vietnam War. This consumption represents more than 90 percent of the energy consumed in Cambodia. We suspect that village usage of renewable resources is underestimated in such calculations.

Electricity: Electricité du Cambodge is the national electric utility. Intermittent years of war, starting with World War II, prevented the company from developing sizable infrastructure outside of Phnom Penh. The civil war that preceded the Khmer Rouge takeover and subsequent ouster curtailed available electricity services further. The reinitiation of electricity services has been slow, and maintenance has been poor. Phnom Penh has recently had only four functioning, small power plants. Cambodia has also recently installed three Soviet-donated diesel generators in Kompong Som, Battambang, and Siem Reap--Oddar Meanchey Provinces. The equipment is prone to breakdown, and much of Cambodia's 23--24 MW of capacity is not operable at any given time.

Electricity is generated almost exclusively for household use. Cambodia remains part of the still existing Mekong River project, which promises eventual electricity projects. In the development of electricity in neighboring Laos, Cambodia has nominally been included as a potential customer. Cambodia has arranged financial credit with the Asian Development Bank to enhance the technical skills of its electricity industry workers.

In May 1994 a U.S. firm, Intercore, offered to alleviate Phnom Penh's electricity problems through the installation of a 105 MW gas turbine power station. The first 35 MW are to be completed by the end of 1995. The prospects for the remaining 70 MW are uncertain. Electricity plans are also progressing for other Cambodian towns. Cambodia lacks the financial resources to develop its electricity resources on its own, though several aid-giving agencies might be willing to provide further assistance. Without such assistance foreign independent power producers, who would be welcomed, might have difficulty locating sufficient foreign exchange to justify sizable investments.

The possibility exists of exporting Cambodian generated electricity to Thailand or, just possibly, Vietnam. For such activity to take place, investors would require assurances of the security of their long distance transmission from civil and military disorders.

2. Laos

Oil and Gas: Laos has not been subjected to intense exploration for oil. During 1989-91 three agreements were made with foreign (including U.S.) consortia to conduct oil and gas exploration on tracts varying in size from 20,000 to 37,000 square kilometers. No significant finds have been announced to date, and Laos is still an oil importing nation. Laos has no refinery.

Oil provides 7 percent of Laos's energy supplies and thus around 70 percent of commercial supplies. Most of this oil is used by the transportation sector. The Soviet Union formerly provided for Laos's energy needs under barter arrangements, but this supply is no longer available under such terms.

Coal: Krung Thai Bank Plc and the Electricity Generating Co. (EGCO) of Thailand have formed a joint venture with the Thai-Laos Lignite Co. (TLL), owned by the Chin Teik Brothers Group. The firm is called the Hong Sa Lignite Co. A power plant would be the second stage of the project. Electricity would be sold to the Electricity Generating

Authority of Thailand (EGAT), Thailand's principal electricity generating and transmission firm. Lignite supplies are believed sufficient to operate a 600 MW plant for thirty years. Other commercial lignite sites in Laos have also been identified, but it is unclear whether Laos is willing to accept the adverse environmental impact that might arise from such ventures.

Hydro: The Mekong River and its tributaries have been estimated to have a hydroelectric potential of 18,000-20,000 MW. Hydroelectric potential is an ambiguous concept, and projected totals are seldom reached. Plans that have gone beyond the initial stages include:

(1) The Houay Hoh hydroelectric project on the Houay Hoh (Hoh Creek). EGAT would purchase the generation from 115 MW of the 126 MW capacity. Daewoo and Loxley Plc are investors in the project.

(2) Nam Cha 1 and 2 and Xe Kaman 1 are hydropower plants planned by Australia's HECEC. The electricity might be sold in Laos, Cambodia, and Vietnam.

(3) Three Nam Ngum hydroelectric projects are effectively separate activities on the Nam Ngum (Ngum River) in Vientiane Province. The Nam Ngum 1 already exists. A memorandum of understanding to build Nam Ngum 2 has been signed. The 400 MW Nam Ngum 3 hydroelectric project would be the result of a Lao-Thai venture sponsored by MDX Power (Thailand).

(4) The Nam Thuen Hin Bun hydroelectric plant in Bolikhamsai Province is contracted to sell 95 percent of its 210 MW capacity's output to EGAT when it starts in 1998. The project is owned by the Lao government, Nordic Power Group, and MDX Power. (The project is also known as Nam Thuen 1-2.)

(5) Nam Theun 2 will be a hydroelectric plant on the Thuen River in Khammouane Province. The 600 MW Lao-Australian-French-Italian-Thai joint

venture is led by Transfield Corp. and would start in 1998. Electricity would be sold to EGAT.

It is not clear whether any of these projects could start on schedule, and other projects are likely to be proposed. There has historically been considerable concern over the environmental impact of these projects, which has affected their design. Environmental concerns are likely to shape future plans as well.

Renewables: In addition to its hydroelectric and lignite contracts with foreign governments, Laos has entered into timber contracts with foreign concerns. These contracts have been criticized on environmental grounds, but are continuing. It is not clear what the impact would be on the availability of fuel wood, the major household energy source in rural Laos. Fuel wood and other renewable resources are believed to supply around 90 percent of energy consumption in Laos.

Electricity: Electricité du Laos is the national utility. Laos is presently not a major consumer of electricity. Publicly provided services are available only in Vientiane and a few other towns. Some border areas are provided with electricity from Thailand and Vietnam. Laos intends to become a major exporter of electricity using indigenous hydroelectric and lignite resources (see above). Laos already exports a large portion of domestically generated electricity to Thailand, and existing plans imply that Thailand's share of Lao-generated electricity might actually increase in coming years. Hydroelectric ambitions have been curtailed by drought due to loss of forest cover to lumber interests. Laos and Thailand's utilities have also had ongoing differences over the appropriate price for electricity exports.

We do not see significant export markets for Laos's electricity elsewhere in the region, even though Vietnam's development ambitions imply that it, like Thailand, might develop an insatiable appetite for electricity. Our reasons for this conclusion, regarding Laos, are primarily based on doubts whether Vietnam will have the foreign capital to buy quantities of imported electricity for at least another decade or so. Indeed, recent

agreements call for the limited export of Vietnamese generated electricity to Lao consumers. We expect that Laos might be a willing seller to any neighbor who can pay, if its domestic electricity requirements are also met. Thailand is the only such neighbor.

The Asian Development Bank and the Swiss are funding (\$17 million) an electricity transmission project to connect the Nam Ngum power station with Luang Prabang. Laos's meager domestic consumption of electricity would be augmented by such plans, but for consumption to grow significantly in gross volumes, more generation activity would have to be devoted to domestic markets than is currently planned. Percentage growth figures for electricity demand would be biased by Laos's small consumption base.

3. Vietnam

General: The lifting of the U.S. economic embargo on Vietnam in 1994 effectively ended Vietnam's economic and political isolation. Development had been taking place for several preceding years, after other international investors anticipated the U.S. move. U.S. firms had also been laying the groundwork for the move as well and consequently did not suffer as much from the delay as they might have otherwise.

Oil: The World Bank has estimated Vietnam's potential oil reserves to be in the 4-6 billion barrel range, though proven reserves are closer to 2 billion barrels. The largest oil field, Bach Ho produced 130,000 b/d of oil in 1993, plus natural gas which is currently flared. Additional oil has been discovered at Dai Hung, which might be exploited by the end of the decade, though the site is considered difficult to exploit. Several other promising sites have been recently discovered, though they tend to be located in basement formations whose potential long term production is ambiguous. Recent exploration experience indicates that Vietnam is more "gas-prone" than "oil-prone," and some industry sources hold that Bach Ho will soon require \$1 billion in investment to prolong its useful life. New fields might replace this production, but, barring continued

discoveries, longer term plans must include the possibility of eventual oil imports late in the next decade. Areas of potential oil and gas exploration in the Gulf of Thailand and the South China Sea are subject to territorial disputes with neighbors. Several offshore exploration and production leases have been let by Vietnam, but significant tracts remain available to interested firms. At least six American firms are there already.

Vietnam is forced to export most of its crude oil production and to import its refined product requirements, since the nation has no significant oil refinery.¹ Several plans to build oil refineries have been announced. The first of these was a 130,000 b/d refinery to be managed by France's Total along with Taiwanese. It was to be located in the south near the most promising oil fields. Total and the Vietnamese government have disagreed over the refinery's exact location, and this project is now seen as in jeopardy. This might imply opportunities for other investors in the south. If a second refinery is built, it is likely to be in the north. Presently, Vietnam consumes around 85,000 b/d of refined products. Oil consumption during 1985-91 grew approximately 9.5 percent per year, a trend that the World Bank expects to continue. Thus while planned refineries will have more capacity than current consumption, this is a condition that might not long continue, even if both are built.

Gas: Vietnam has targeted the establishment of a large natural gas industry by 2000. This goal is based partly on expected discoveries from its present exploration activities. Officials estimate that 4-5 billion cubic meters per year of natural gas will be available by that time (roughly equal in energy to 270-330 million barrels of oil). In 1994 construction began on a 107 km gas pipeline from the offshore Bach Ho oil-gas field to the mainland. Further expansion of the line is expected during 1995-96. Gas from the field will be used to generate electricity in Ho Chi Minh City and Vung Tau, and 300,000 tonnes/year of LPG from the condensates should be available for exports. While power generation will consume most of Bach Ho's gas output, some gas might be allocated to

¹ An 800 b/d refinery is reported at Cat Hai near Ho Chi Minh City.

industry, including ceramics and glass. Some natural gas reserves in Thai Binh Province in the north are currently also being exploited.

There are several potential natural gas fields in Vietnam, especially offshore. These generally coincide with potential oil sites. Development of these reserves will require more clearly delineated government policies and pricing terms for investors. Recent efforts to promote hydroelectric schemes will affect the potential to develop natural gas for electricity generation, one of the chief potential markets for gas. Gas fired electricity is likely to play a major role in Vietnam's domestic future energy mix, if further gas fields are proven and developed. Gas developments will also depend on the ability to attract investors to fields that have relatively low potential to produce crude oil, which is more readily prepared and priced for export markets. Some companies are investigating the possibility of exporting gas to the rapidly growing Thai market via connections to existing offshore Thai pipelines. Southern China is another potential market. The export of gas to northern Asia in the form of LNG is also being considered. For any of these plans to develop, gas reserves will have to be specified with more certainty.

Coal: Vietnam has four national coal companies. Thermal coal is used in three power plants (totaling 635 MW) in the north. New coal fired plants are planned. The reserves in Quang Ninh Province in the northeast have been estimated at 2.3 billion tonnes of anthracite, plus small amounts of semianthracite and poorer quality coals. Seams are comparatively thick, good quality, and near the coast, but development might be affected by the attractiveness of the same locations to tourism. Export facilities have been criticized as inefficient. Annual coal production was 4.8 million tonnes in 1993 and an estimated 4.9 million tonnes in 1994. Approximately 2.3 million tonnes of coal are exported each year, notably to Japan and South Korea. Most of the world's steam coal consumption is bituminous and subbituminous coal, and therefore markets for anthracite are limited. Some modern plants are sufficiently flexible, however, to include anthracite among their fuel options.

Hydro: The Hoa Binh (Peace) hydroelectric plant in northern Vietnam was completed in 1994 after fifteen years of construction. Its eight turbines have 1,920 MW of capacity and accounted for 45 percent of Vietnam's electricity capacity in 1994. Vietnam has several other large hydroelectric facilities on its drawing boards or under construction, including Yali (700 MW), Chian (408 MW), and Da Nhim II (380 MW). A project being studied in Son La Province might have 2,400–3,600 MW of capacity. The Son La site would displace as many as 100,000 people and for this reason is possibly unacceptable to local political interests and to international donors. Some 570 potential sites have been identified, including ten with potentials of more than 300 MW each. Hydroelectric capacity in Vietnam is subject to significant seasonal variations that would necessitate parallel thermal facilities to handle low flow periods and droughts.

Vietnam, Cambodia, Laos, and Thailand have participated in a sequence of Mekong River projects that have sought to jointly develop that river's resources. These plans have been frequently interrupted by wars and disagreements but appear to be coming back into existence.

Nuclear: We know of no nuclear electricity generation plans in Vietnam. If Vietnam's ambitious development schemes bear fruit and as concepts of national prestige grow, we would not be surprised to hear of such ideas. Nuclear electricity is not cost effective in most cases, thus we doubt that much foreign financial support would be found or that such developments might take place soon.

Renewables: It is estimated that wood, bamboo, biomass, and rice straw provide around 60 percent of Vietnam's primary energy consumption. Such estimates are always approximations, but a share of such magnitude indicates considerable room for contributions from marketed energy. Vietnam has a national program to develop new and renewable energy sources, indicating receptivity to microhydro, solar, biogas, and wind energy projects. We do not expect these activities to make major contributions to the national energy picture, though they might meet local energy needs.

Electricity: Vietnam has three national electricity companies that service separate districts of the nation. Power Company No. 1 serves the north, Power Company No. 2 the south, and Power Company No. 3 the central region. In 1993 10.6 GWh of electricity were generated by existing thermal and hydro plants. Generation of 11.5 GWh was expected in 1994. Consumption of around 24–27 GWh is expected by 2000.

The government hopes to spend \$4 billion to build nine power plants by 2010. This is expected to be sufficient to allow electricity production to grow by as much as 18 percent per year. There are also plans to build 5,000 km of high tension transmission lines, 77,500 km of medium tension lines, and 150,000 km of low tension lines. Goals target the installation of 13,000 transformers. These numbers are ambitious, though rapid growth in the electricity sector is as likely as growth in any energy sector of Vietnam.

Around fifty million of Vietnam's seventy million people do not receive electricity from the national grid. Present targets seek to meet the electric power needs of broad sections of the nation, with residential consumption growing most rapidly. Despite these intentions, we expect that Vietnam will instead follow the pattern of many other nations by allocating its scarce resources to industrial needs first. An early target is the interconnection of the northern, central, and southern regions into a single 500 kV transmission line. While this would initially allow northern hydroelectric and coal facilities to supply the south, natural gas fired plants in the south might eventually export electricity to the north. Any eventual result should be a product of the relative economic growth of the two regions. Transmission losses are estimated at around 25 percent, perhaps indicating the rather inadequate metering of electricity. It can be expected that Vietnam will seek foreign assistance in monitoring electricity use.

It seems likely that national electricity goals can be approached only with the participation of independent power producers. Recent plans have included such activities by Taiwanese and Australian firms. Many recently announced projects involve natural gas as the principal fuel. Other electricity projects have involved Japanese foreign aid.

Petrochemicals: Vietnam is one of the largest countries of the world without a large domestic petrochemical industry. The meager state of the petrochemical industry is partly due to inadequate domestic resources to fund such capital intensive activities. We expect that, if recent oil and gas discoveries come to fruition and if initial indications that Vietnam has begun a period of rapid economic progress prove to be correct, this capital will be available soon. Plans to produce base petrochemicals (in this case, ammonia) involve the allocation of gas from the Bach Ho field to a fertilizer facility in the Mekong delta area. This project would also produce urea (500,000–600,000 tonnes/year). Vietnam already produces 60,000 tonnes/year of urea at other sites. Some versions of the plan also imply the production of methanol from the gas, though the proposed facility would be small (20,000–30,000 tonnes/year).

Several small projects to produce intermediate and end use petrochemicals have been announced, but no firm plans to produce olefins have been proposed. Domestic polymer processing was estimated at 83,000 tonnes in 1993, compared with 25,000 tonnes in 1990. (Plastics consumption was 65,000 tonnes in 1990 and 130,000 tonnes in 1993.) In 1990 some 27 percent of the total plastics consumption was polyvinyl chloride (PVC), while that share was only 19 percent in 1993. Most of the increase in plastics consumption was in polypropylene and polyethylene film extrusions. Raw materials (polymer resins) were imported.

In 1994 four Japanese and Vietnamese firms proposed building a 60,000 tonnes/year PVC plant in Ho Chi Minh City, which is scheduled to start in June 1997. The production would replace PVC resins imported by the Japanese partners from Thailand. Elf Atochem has also considered PVC production in Vietnam. Also suggested for Vietnam is a small nylon-6,6 project led by Rhône-Poulenc and scheduled for completion during 1995. Purified terephthalic acid, polyester, and styrene monomer capacity have also been encouraged by the government, though no commercial plans have been announced. Such investments in derivatives often precede more extensive base and intermediate petrochemical investments. These particular projects might imply both

aromatics and olefin activities. We expect that a foreign partner would be sought before olefin activities are undertaken, and that such production is inevitable, perhaps in the distant future.

IV. Expected Industry Trends

With the assistance of a little luck, Indochina is well positioned to join Asia's recent record of impressive economic growth. Its leaders and people are aware of the success that is being achieved around them, and they are prepared to emulate it—to the extent that their social and political systems permit them. Vietnam, with the largest population among the three countries and its lengthy coast, seems poised to be the first nation in Indochina to succeed, even though it had a late start. This is also true even though Vietnam still has a government that seeks more strongly than do the governments of Laos or Cambodia to retain elements of the autocratic Communist past. The domestic issue for the government is, of course, how to meet recognized needs of the economic system without disrupting political power.

Vietnam and to a lesser extent Laos and Cambodia are well positioned to take advantage of future trends in energy and energy-related markets. Vietnam has commercial oil and gas reserves. Firms would not be exploring in Laos or Cambodia if they did not hope that those nations also had commercial hydrocarbon potentials. It remains to be seen whether reserves are sufficient to permit a hydrocarbon export industry to develop. There is particular optimism for gas in Vietnam, but if the economy develops on schedule or if reserves deplete as rapidly as is feared, known oil reserves might not be sufficient for long term domestic needs. Gas reserves will probably be found to be more abundant, and Vietnam's location might eventually permit eventual exports to either southern China or Thailand by pipeline. If such markets develop, LNG investments would make sense only if gas supplies are truly abundant relative to domestic needs.

Hydroelectric supplies alone are almost never sufficient to meet the needs of a developing country, though they can help. The share of hydroelectricity in local electricity supplies might grow for a while, as a result of large projects, but viable and truly vacant sites will decline in number with time. Hydropower is subject to seasonal variations that might not match consumption seasons, thus hydro usually has to be augmented by more conventional power. The ongoing development of regional power grids might accomplish this more effectively than siting conventional power plants in areas now served by hydro. Northern and central Vietnam might, for example, become hydroelectric producing areas, while the south (oil and gas) and north (anthracite coal) provide thermal power. It is perhaps too early to talk of base versus peak load needs in Vietnam, but the period when they become a concern might come soon, if economic development continues. Hydroelectric power might gradually evolve in such an environment into a peak load source. If economic success is achieved, Vietnam might also evolve into a net importer of electricity from neighboring nations.

Electricity is barely consumed in Laos and Cambodia, though Laos is poised to become a notable net exporter of hydroelectricity and lignite-fired electricity to Thailand. This market is available to Cambodia, if it can identify a fuel. Laos is already providing some small communities with electricity purchased from Thailand and Vietnam. Cambodia is still worried about supplying cities and towns. Consumers certainly want the modern life that electricity makes possible, and therefore interests in both Laos and Cambodia are bound to shift from the export of electricity to the provision of local supplies.

Table 1 identifies areas of the energy industry in which investment might be possible in each of the three nations of Indochina. The word "yes" does not imply that the option is currently open or that policies are in place. It implies potential.

Table 1. Current investment potential in Indochina

Sector	Cambodia	Laos	Vietnam
Upstream oil	yes	yes	yes
Refining	no	no	yes
Domestic marketing	no	no	no
Upstream gas	yes	yes	yes
LNG	no	no	yes
Electricity	yes	yes	yes
Petrochemicals	no	no	yes

Note: All conclusions are judgmental.