Coal: CLW Memorandum – "Energy Problems of Oil Importing Developing Countries," Mar. 1981

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Energy Problems of Oil Importing Developing Countries (OIDC's)

(Notes by Carroll Wilson, March 1981)

A. Circumstances of OIDC's

In formulating energy policies and programs many OIDC's confront the following situation:

1. A large fraction of their energy needs are for cooking fuel in the rural subsistence sector (woodfuel, dung, agricultural wastes) and lies outside the monetized system. Woodfuel supplies in many areas - especially in arid zones - are being depleted much faster than they are being replenished through afforestation.

2. Charcoal from wood is the principal fuel for cooking and heat in urban areas with kerosene and/or LPG products for cooking being widely used in some places. Coal is used for cooking in a few places where it has been traditionally available.

3. In the modern sectors (transport, electricity and industry) imported oil supplies nearly all of the primary energy with motor transport taking half or more and thermal electric plants and industry (cement, pulp and paper, breweries, textiles, etc.) dividing the remainder.

4. Although coal is mined in 30 developing countries, India accounts for half and Yugoslavia, Turkey and the Republic of Korea for much of the rest.

5. Payment for oil imports takes an increasing fraction (as much as half) of all export earnings and

has been financed since 1974 in large measure by loans whose mounting debt service is becoming insupportable.

B. Possible Pathways towards Solutions

1. Discovery of oil and its production would provide the most useful and quickest way towards a solution of problems in the modern sector and even in the urban cooking fuel market (kerosene and LPG). The oil might be exported in exchange for imports of refined products to match internal needs for gasolene and diesel fuel, kerosene, fuel oil, LPG, etc., or some or all of the oil might be refined in the country although small refineries are unlikely to be able to refine the barrel into the fractions which meet local needs - too much fuel oil, too little motor fuel.

   Obviously the size and location of such an oil field and the cost to produce and transport it to an export terminal or to a domestic refinery would be major factors affecting the scale and speed with which such an oil field would provide relief for the circumstances described under A.

2. Discovery of a gas field could be important for the OIDC but it would present many more problems than oil. If it were a giant field it might justify the very large investment involved in an LNG system. If it were a small field it might be moved by pipeline to urban and/or industrial users within the country if distances were short. Use of natural gas liquids from gas production or associated gas in oil production present other possibilities for meeting fuel needs in the OIDC.

3. In OIDC's coal mined and used as a substitute for oil in industrial uses especially cement, pulp and paper and breweries warrants consideration.

On the world market (the price for coal imports) coal is selling at 1/3 or less than the price of oil on a heat equivalent basis and it is widely believed that such a differential is not likely to diminish much in the future. Thus coal from domestic production or coal imports offer rather large savings over oil but significant capital investment is required to convert from oil to coal and to establish necessary port facilities to handle coal imports. Choices are made more complex because there may be a surplus of fuel oil from the local refinery which may not move readily into the export market. For new projects such as thermal power plants and many industrial uses imported coal offers a much less expensive fuel than imported oil. Annex A reviews some of the problems and opportunities in the use of coal in developing countries.

4. While technical and financial assistance is now becoming available from the World Bank and some other sources for exploration for coal, the financial and mangerial requirements for developing mines and mining and moving coal to markets are formidable. Annex B from a recent World Bank Review of coal production potentials of OIDC's indicates the nature of such problems. Thus the discovery, development and domestic use of coal where it has not in the past been mined or used is not likely to offer a feasible pathway for early relief from the OIDC dilemmas.

5. For some tropical countries where there is abundant land and water for sugar cane, production of ethanol for motor fuel offers a possible pathway towards relief. Brazil illustrates what can be done in a relatively short time firstly to replace 20 percent of gasoline by ethanol and then to move towards 100 percent ethanol fuel for cars and trucks with engines adapted to use straight alcohol. Very little new technology is needed either in ethanol production or engine modifications to run on alcohol.

6. Except for biomass for alcohol production, solar energy appears to offer little early relief for OIDC problems in the modern sector. In the rural or subsistence sector solar cookers have been used very little because mid-day cooking does not fit traditional cultural patterns. Windmills for water pumping have a long history in some countries but may have limited use where they are unknown. Photovoltaics are a new, sophisticated, capital intensive technology which may not become important in developed countries before the end of the century and later in OIDC's. Biogas digesters for methane and fertilizer production have become important under special circumstances in one province of China (Sichwan - 5 million units), small penetration in the rest of China (2 million units), and almost no penetration elsewhere. It is a sophisticated process of biological engineering to operate and very demanding in construction of gas-tight 10 m^3 structures made from local bricks. In India where about 100,000 units are in use the gas sphere is metal and costs about $500. This is for a 10 m^3 system sufficient for one family.

   There is every reason to press forward with such technologies for their potential importance after the turn of the century. None are likely to provide significant relief for the energy problems of rural or modern sectors much before the end of the century.

7. The indispensable renewable energy resource required for most developing countries is an expanding (not shrinking!) supply of woodfuel for cooking in the subsistence sector and to make charcoal for the urban areas. Annex C is a description of some aspects of this paramount problem of most OIDC's. Little new technology is needed but exceptional management will be required to establish and nurture and protect to maturity the tree plantations which are essential to meet the cooking fuel needs of a doubled rural population by the year 2000. The side effects of such expanded afforestation will be

highly beneficial in arresting soil erosion, reducing flooding, etc. Annex C describes woodfuel problems and some substitutes.

A widespread perception of the problem must precede decisions and action by governments at national and local level to expand by a factor of 5 to 10 current rates of afforestation. It also demands a continuity of government policy and determined action which is rare in any nation and especially difficult for OIDC's. While some aid from outside may be useful, the solution of these problems rests squarely on the people of each nation. Annex C is a description of some aspects of the woodfuel situation including some of the problems of coal use as a cooking fuel.

C. How Shall Choices Be Made?

This brief recitation of the circumstances of OIDC's and some possible pathways towards finding solutions to their problems shows rather clearly the problems of analysis of the trade-offs among various pathways towards solutions of OIDC problems. Few industrialized countries have been very successful in defining and executing programs intended to relieve their acute energy problems. Thus it is not surprising that the public and private sectors of OIDC's have not yet developed a capacity for analysis of their energy problems and assessment of various mixes of policies and programs which hold some promise of bringing relief from the more acute effects of their circumstances today.

The fragmentation of energy know-how into many specialties makes it especially difficult for OIDC's to find assistance in analyzing their choices and learning how to proceed with the deeper studies of feasibility which may lead to programs of action. There is then the next stage of translating plans into action with all the many strands of people, finance, operation, etc. There are specialists of many kinds whether they be makers of equipment or sellers of coal. But OIDC's face real difficulties in getting

assistance from knowledgeable persons who can take a holistic view of the energy situation of an OIDC, who have no specialty to sell, and who are free to search for solutions to these problems which are in the best interests of each state.

All of this suggests the need for energy advisory services which can find satisfaction and profit in finding pathways for solutions of OIDC's' problems and in finding ways to help the OIDC move ahead towards greater energy independence and stability.

a) Coal Use in Modern Sectors of OIDC's

As an introduction it is useful to consider the heat equivalents of coal, gas and oil in the following table.

Cost of Coal, Natural Gas, and Heat That Are Equivalent to Various Oil Prices

Fuel Type	Oil Price		
	$20/barrel	$30/barrel	$40/barrel
Coal ($ per tce)	$95	$142	$190
Natural Gas ($ per thousand cf)	$3.30	$5.00	$6.60
Heat ($ per million Btu)	$3.40	$5.10	$6.80

Although the motor transport sector may account for half or more of the commercial energy used in many OIDC's, there are other sectors such as electric power, cement, breweries, pulp and paper, smelters, etc., where coal can be substituted for oil with the potential of reducing oil use by as much as one half. Moreover, coal if imported would be obtained from different suppliers than oil with possibilities of different or special trading relationships with such suppliers. The following are important questions to weigh in any substitution of coal for oil: probable future prices of coal in relation to oil; coal prices in relation to residual oil; and availability of coal using equipment. These topics are considered in the following sections:

b) Coal Reserves, Prices and Markets

It is a conclusion of WOCOL that over the long run coal prices will be related to coal costs (1) because of large reserves which are attractive to mine at prices at the mine of not over $60/ton ($12.50/b oil equivalent), and (2) the world coal market is expected to remain competitive without price-fixing cartels. Clearly coal prices will rise as more coal comes from new and more expensive mines and transport systems. Also, in the short run coal prices could rise quite abruptly if demand outruns supply. This is not considered likely because coal using equipment (e.g., power plants) have longer lead times than the links in the coal supply chain. Thus the present differential of 2-4 fold is expected to continue and may increase if oil prices rise faster than coal prices.

B. Possible Pathways towards a Sustainable Future

1. Reforestation and Afforestation

The calamitous consequences of fuelwood depletion are beginning to be recognized as indicated by the rising volume of current studies. It should become a top priority for national policy and action to arrest fuelwood depletion and expand output to meet the needs of expanding populations. But progress may be slow because of the many social and institutional obstacles to afforestation, the care and protection of trees until maturity and equitable sharing of fuelwood from tree plantations for use as fuelwood and for charcoal to meet rising urban needs. There are of course many beneficial side effects of expanding forests. The World Bank has major programs in this field ($300 million for 1979-83) and some bilateral aid agencies are expanding their activities in this field. The importance of the social implications of wood-related activities, the role of women and the need for close integration with rural development cannot be overemphasized. Afforestation alone is not likely to meet the woodfuel crisis.

2. Factors Affecting Coal Use

With rising prices for charcoal in urban areas coal may become a substitute if several conditions obtain such as the following:

a) Coal exists in urban areas because it is already used in the modern sectors. If imported, port facilities exist to handle bulk cargoes.

b) Simple, low-cost, locally made stoves are available in which coal can be burned for cooking and they are used by families. This requires changed cooking methods.

c) The price of coal is sufficiently below prices of charcoal or petroleum products to induce consumers to make the investment and effort needed to use it.

In the following sections these three conditions are considered:

Coal in many places competes with residual fuel oil which historically has sold at a 15% discount and sometimes as much as 50% below crude oil prices. The supply of residual oil and its discount below crude oil is expected to decrease in the future as oil refiners convert a larger fraction of the crude oil barrel into lighter fractions.

Coal handling and using equipment is more expensive than equipment for oil so that the capital cost of a coal-fired power plant or receiving port is higher than an oil-fired plant or port. Coal conversions in cement, pulp and paper, smelters and a wide range of industrial uses is well-established. The technology is well developed, steadily improving and equipment is available from firms in many countries. Substitution of coal for oil and gas is accelerating in many industrialized countries.

c) Problems of Coal Substitution for Charcoal for Cooking

Substitution of coal for charcoal presents considerable problems. Although about the same calorific value as charcoal, coal is less reactive, harder to ignite and requires a greater mass if the fire is to stay alight. Having a density 3-4 times that of charcoal, a coal fire of the same volume will produce a much hotter fire with overheating and burning problems in cooking. Volatiles in coal produce a smokey flame which may be sulfurous. If coal is burned inside a dwelling it must be burned in a suitable stove with chimney or it can be dangerous because of carbon monoxide.

Thus there are a series of significant obstacles to the substitution of coal for charcoal as cooking fuel. Nonetheless coal appears to be the only low cost fuel which can compete with charcoal and relieve pressures on woodfuel. Suitable stoves for coal are available in various countries but it is not easy to persuade people to use them. A substantial price difference between charcoal and coal would be needed to induce people to change equipment and cooking methods.

d) Factors Inducing Coal Substitution for Charcoal

If coal can be imported at $60/ton and reaches consumers at $180/ton it would now be about the same price as charcoal in Dakar, for example. Better distribution could reduce the price to the consumer. But it might take a differential of 2-3 fold to lead consumers to switch from charcoal.

The time lag in the rise of charcoal prices to 2-3 times coal prices may take some time. Ensuring the availability of coal in LDC's to meet such a future demand is a good reason for considering coal use in large-scale applications in the modern sector where coal substitution for oil offers large savings now. This would bring coal into urban markets where it might begin to be substituted for charcoal in bakeries, for example.

C. Coal Use in Modern Sectors of OIDC's

1. Financing Problems

The growth of the modern sectors in OIDC's is very dependent upon the ability of such countries to finance their futures. Large borrowing to help meet rising oil import costs and debt services approaching unsupportable levels in relation to export earnings makes very uncertain their access to the capital needed for new and expanded facilities in the modern sector and for the fuel imports to make such facilities useable.

2. World Bank Estimates of Energy Use

Despite a recognition of such uncertainties the World Bank has recently issued a report on Energy in Developing Countries (December 1980). From that report Table 23 shown below projects for the OIDC's a doubling of production and consumption of primary energy between 1980 and 1990. It shows a rise in oil imports from 4.5 mbd in 1980 to from 6.6 to 7.8 mbd in 1990. At 7.8 mbd and oil at $40/b the oil import bill in 1980 dollars would be $113 billion.

Table 23: DEVELOPING COUNTRIES: PRIMARY COMMERCIAL ENERGY BALANCES, 1980 and 1990

(Million barrels a day of oil equivalent)

	OIDCs			
	1980		1990	
	Prod.	Cons.	Prod.	Cons.
Oil	2.0	6.5	3.6/a	11.4
Gas	1.5	1.4	2.6	2.6
Coal	2.4	2.5	3.3	3.4
Hydro	1.5	1.5	3.2	3.2
Nuclear	0.1	0.1	1.0	1.0
Other/b	0.3	0.4	1.5	1.2
Total	7.8	12.4	15.2	22.8

/a Production level projected in Case 1, as described in Chapter II. The production level in Case 2 is 4.8 million barrels a day of oil.

/b "Other" includes alcohol, other nonconventional primary energy sources, unallocated energy, and exports of gas.

Sources: World Development Report, 1980 and World Bank staff estimates.

3. World Bank Estimates of Electricity Expansion

Annex 1 is Table 20 from the World Bank Report showing projections of Electric Power Generating Capacity 1980-90 for Developing Countries. Thermal oil is projected to rise from 90 to 129 GW(e), thermal gas from 12 to 60 GW(e), coal/lignite from 35 to 92 GW(e) and nuclear from 3.4 to 38 Gigawatts. Totals including hydro (99 to 201) rise from 241 to 523 GW(e) in ten years.

Such a rise in total capacity in developing countries or an additional 282 gigawatts implies investment in power stations of $282 billion (at $1000/kw) with substantial additional investment in transmission and distribution systems plus

machinery or lighting to use the added electrical output. This might equal the power station cost making a total of $500 billion or an average annual investment of $50 billion a year during this decade.

This needs to be compared with the total of funds raised by borrowers for all purposes in international capital markets 1975-78 (Table 8-4, page 219 of WOCOL Report) which increased from $31 to $87 billion with the LDC share being about 45% or in 1978 about $41 billion (47% of 87 billion). Most of this was increased Eurocurrency credits which rose from $20 billion in 1975 to $72 billion in 1978 of which 53% was for LDC's.

In the WOCOL Report it was estimated that the net additions to coal fired electric capacity in the OECD countries 1977-2000 would be 740 GW(e), nuclear additions about 300 GW(e), very little gas, oil or hydro, for a total of about 1040 GW(e) over 23 years or an average of 45 GW(e)/year. At $1000/kw capital cost this amounts to $45 billion a year average. It seems unlikely that the rate of investment in electric power capacity in developing countries will be nearly as large as such investment in the OECD countries.

4. An Example of Estimated Savings in Using Coal vs. Oil

If the large differential between oil and coal prices leads in the LDC's to substitution of coal for oil on an increasing scale in industry the demand for coal imports could rise substantially. For example, a new 250 MW power plant would use about 500,000 tce of coal per year. At current cif prices of $60/ton ($12.50/b)* the annual fuel cost would be $30 million. Assuming the same thermal efficiency in burning coal and residual oil at $30/b or $142/tce (85% of a crude oil price of $36/b) the annual fuel cost using coal would be $71 million or a difference in favor of coal of $41 million/year in annual fuel cost. This differential would be reduced as a result of various environmental control measures which would add to the cost of burning coal. In Japan which has the most stringent environmental standards in the world the Japanese

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*Paragraph 251 of the World Bank Report states world market prices of thermal coal at $30-36/tce or $6-8/b of oil equivalent.

WOCOL team estimated that it could add as much as $35/ton to the cost of coal to meet such standards. If an LDC had comparable standards the cost of using coal would rise to $95/T ($20/b). There would still be an annual saving of $142-95 or $47/T or $23.5 million per year for the 500,000 tce of coal used.

5. Potential for Coal Production in LDC's

In October 1979 the World Bank published a report, Coal Development Potential and Prospects in the Developing Countries. The summary of this report is attached as Annex B.

Between 1973 and 1978 coal production in LDC's increased from 130 mtce to 162 mtce (5.7% of world total). Although coal has been found in 50 LDC's and there is some production in 30 countries, nine producers account for 90% of LDC coal production - Brazil, Colombia, India, Korea, Mexico, Romania, Turkey, Vietnam and Yugoslavia. This concentration is not expected to change much in the next decade.

Exploration and pre investment work has been done in almost all coal producing LDC's since 1974. In 16 countries coal mines are being developed which should produce 25 mta by the late 1980's. The high risks and high capital costs of the development of coal mines and related infrastructure including transport has resulted in little investor interest up to this time. Most LDC's have neither the human and financial resources nor technical know how to develop coal mines and must depend almost entirely on outside agencies for finance and execution of projects.

6. The Importance of Imported Coal

In this memorandum attention is focussed on imported coal for the large number of OIDC's which have no coal production nor current prospects for future production. Wherever indigenous coal can replace imports at comparable prices it will of course be advantageous to use it. Unlike oil which has generally been imported, coal has not in the past been considered as a fuel unless it was produced domestically. Now and in the future coal should be regarded as a commodity in world trade to be substituted for oil and other fuels when it is economically advantageous to do so.

7. World Steam Coal Trade and Ports

Steam coal was an important part of world trade before the oil era. By 1977 it had fallen to about 50 mta in a world then using about 2.5 billion tons of coal. Estimates by WOCOL indicate an increase in coal trade to 700-1000 mta by the year 2000 in a world then using 6000-7000 mta. To carry 1 billion tons of coal would require 1000 ships of 100,000 DWT on the long trade routes. It is expected that a large fraction of such ships will be coal-fired. A large expansion of ports to handle such trade will be needed.

Such a volume of trade in which there will be ships of many sizes should give OIDC buyers a choice of sources and assurance of regular deliveries. This is a new situation and has not yet been perceived by many coal users.

An objection to use of imported coal in OIDC's has been that adequate port facilities do not exist and would be very expensive to build. WOCOL estimated terminal investment costs (Table 6-5, p. 178) at $10-13 per metric ton annual throughput for receiving terminals with an annual throughput of 2-4 mta. For a smaller volume(500,000 ta needed for our example of the 250 MW power plant) a figure of $20/T would lead to a capital cost of $10 million. This capital investment is a small fraction of the annual saving in using coal in place of oil.

Conversion of existing kilns for cement manufacture has a payout of 2 or 3 years in many places by substitution of coal for oil. Thus the OIDC building the power plant in the example would probably install capacity to handle steam coal for a number of industrial uses as well as for the 500,000 tce electric power generation.

8. The Example of Thailand

The power of market forces which is moving industrial users in many countries to convert to coal is also moving some of the LDC's. A good illustration is the article, "Thais Turn to Australian Coal," from the Far Eastern Review. The challenge is to assist another 100 OIDC's to assess the economics of coal conversion using imported coal and how they can take the steps to "get from here to there."

Table 20: DEVELOPING COUNTRIES: POWER GENERATING CAPACITY, 1980-90

	1980		1985		1990	
	Gigawatts	Percent	Gigawatts	Percent	Gigawatts	Percent
Thermal/a						
Oil	90.3	37.4	112.2	31.3	129.1	24.7
Gas	12.5	5.2	29.9	8.3	60.7	11.6
Coal/Lignite	35.1	14.5	58.2	16.2	92.2	17.6
Subtotal	137.9	57.1	200.3	55.8	282.0	53.9
Hydro	99.6	41.3	147.0	41.0	201.3	38.4
Nuclear	3.4	1.4	10.2	2.8	38.1	7.3
Geothermal	0.4	0.2	1.4	0.4	2.3	0.4
Total	241.3	100.0	358.9	100.0	523.7	100.0

/a Estimated fuel breakdown based on primary fuel (some stations are dual fueled).

Thermal power will remain the dominant form during the 1980s although its share will decline; coal- and gas-fired generation will increase at the expense of oil-fired. Hydropower capacity is expected to double, although its share in total electricity production will drop slightly. Nuclear power, presently confined to a few developing countries, will increase its share of production substantially during the decade.

Source: World Bank staff estimates.

Thais turn to Australian coal

Planning is not going fast enough for electricity authorities, who need expensive construction work to import large quantities

By John McBeth

Bangkok: Australian coal is expected to start arriving in Thailand next year as the Thais try to hold down an oil bill that now gobbles up 46% of foreign exchange earnings. Deputy Premier for Economic Affairs Boonchu Rojanasathien, Commerce Minister Tamchai Kamphato and Electricity Generating Authority of Thailand (EGAT) general manager Kasame Chatikavanij are studying a preliminary report by Australian experts about building a coal-handling port southeast of Bangkok and the creation of a national coal purchasing authority to manage imports of up to 12 million tons by the 1990s.

The government has yet to make a decision, but Australian officials say once the Thais have committed themselves to coal, as seems inevitable, they will be encouraged to sign long-term contracts in exchange for an assured supply and known price limits.

Because it costs roughly US$250 million to open a coal mine, the Australians prefer to have at least three-quarters of the deposits pre-sold under long-term commitments with a reasonable set price for the first year and provision for negotiations after that to accommodate an estimated annual 7% increase in the price of coal over the next decade.

Coal from New South Wales and Queensland mines has high calorific value, low ash yield (15-20%) and a sulphur content of less than 3%, which puts it below that of lighter oils. The net effect is that one-and-a-half tons of coal produces the same energy output as measured in British Thermal Units (BTUs) as one ton of oil, and is US$70 cheaper – US$110, compared to US$180.

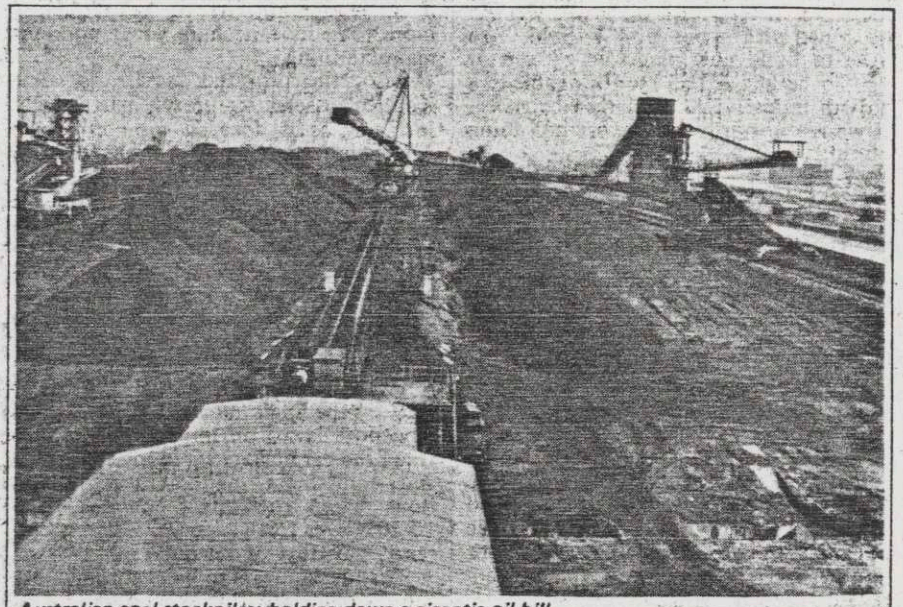
Kasame says he sees an important role for coal in power generation, but that progress is slow. "Right now the energy picture is so confused it is hard to get commonsense decisions made," he told the REVIEW. "There are too many sources of decision-making."

The initial coal users will be Thailand's three cement companies – Siam City, Siam Cement and Jalaprathan. Siam City says it will spend Baht 300-400 million (US$15-20 million) in the next two years to change the kilns at its two plants from oil to coal. Siam Cement, the largest conglomerate, has tenders from five companies to convert those facilities which can be reached by water transport. Other transport methods are too expensive.

Jalaprathan, already converting its Cha-am plant, 75 mi. southwest of Bangkok on the Gulf of Thailand, is ideally placed for the changeover – bulk carriers of about 30,000 tons will anchor off Cha-am and unload coal into 1,000-ton barges. Freight and unloading charges will be about US$40 a ton, but with efficient equipment that can be cut to as little as US$28.

The government is considering plans to build an unloading facility which does not require extensive dredging. Two possible sites are the southwest corner of Si Chang island, 45 mi. southeast of Bangkok, and Ao-phai on the adjoining mainland near the site of Thailand's now-shelved nuclear power station.

Experts say the island location would need a half-mile jetty, estimated to cost about US$1.5 million, and US$80-100 million worth of machinery, including high-speed conveyors, an irrigation and drainage system, pollution control equipment and a loading pier for barges.



Australian coal stockpiles: holding down a gigantic oil bill.

There may also be a six-mile causeway linking the island to the mainland.

Kasame may prefer Ao-phai, however, because the site originally reserved for the nuclear plant will now be used for a 2,400 mw. coal-fired power station using 6 million tons of coal a year. Work is expected to begin next year.

According to estimates, the new port would handle one bulk carrier of 110-250,000 tons every three or four days, with each ship making a 28-30-day round trip. The Australians have suggested a stockpile of 3 million tons administered by a coal authority which would either buy the coal and sell it directly to EGAT and cement producers, or simply be a conduit, leaving purchases to consumers.

Jalaprathan will take delivery of the first 200,000 tons of coal for its newly converted plant next year, but that is roughly half of what it will need when it goes into full coal-fired operation in 1982. Business sources expect cost savings of up to 30%. Imports are estimated to rise to 900,000 tons in 1982, 1.7 million tons in 1984, 2.2 million tons in 1986, 4 million tons in 1988 and 8 million tons by the end of the decade as coal becomes an increasingly important factor in EGAT's expansion plans.

Kasame is determined to get out of oil completely and is juggling a mix of natural gas, lignite and coal in his forward planning now that the completion of the Srinagarind dam across the Kwai Yai river has all but exhausted sites for large-scale hydroelectric projects.

Gas from the Gulf of Thailand is scheduled to start flowing in October next year and will be linked by 375 mi. of offshore and overland pipeline to EGAT's Bang Pakong and South Bangkok plants. Initially the plants will use 200 million cu. ft a day, rising to 250 million cu. ft by 1982. Usage will not go much higher because of the need to develop industry and because gas can be employed more profitably than to make steam for electricity generation. As Kasame put it: "It won't be limited in years, but in the amount used over the years."

While Thailand will benefit from the accrued royalties, gas does not represent any significant saving for EGAT. Kasame says the price will be about US$3.75 for 1,000 cu. ft, or 70-80% of the prevailing oil price, and is subject to increases.

Lignite is being used to fire the Mae Moh power station in northern Lampang province, which has two 75 mw. units operating and a third due to go into operation next July. A 150 mw. unit is planned for early 1984. Mae Moh has proven deposits of 150 million tons and a further 500 million tons of probable reserves, allowing for substantial future expansion.

Coal, however, remains the main alternative – at least in the foreseeable

future and as long as the Thais retain an inherent fear of nuclear power. Conversion of the 175 mw. oil-fired Bangkok North power station is likely to begin next year and by 1983 it is expected to be using about 400,000 tons a year. Coal power will also probably be used in expansion of the Ban Prakong thermal plant, a giant open-ended undertaking that is designed to pump 2,290 mw. into the national grid.

Two 550 mw. units, scheduled to be completed in 1983 and 1985, will be gas-fired, but the third and fourth units planned for five years after may use coal – about 3-4 million tons a year. Other plants which will be needed through the 1990s may also use coal if EGAT is to keep ahead of energy demand, now rising at 15% a year. Some planners estimate another 5,000 mw. will be required between 1990 and 2000.

But Kasame has planning problems, largely because successive governments have tended to put political considerations ahead of economic realities. "I realise the hardship to people if we raise power rates higher, but if they are not increased in step with oil prices we will be stuck with a big gap," he said. "We have to build new plants to get out of oil. To be in the red is unthinkable in a growth industry, particularly electricity. If we are not growing, we are not doing our duty."

Kasame resigned from the Kriangsak Chomanan government in November 1979 after it turned down his request for a price increase. The new rate would have given EGAT what it saw as an essential 6% return on investment, 2% to cover interest on loans and 4% for expansion. The World Bank responded by freezing about US$150 million in loans which had already been negotiated for new projects.

Because that had the effect of closing other loan sources, particularly in the Middle East, the government was forced to reconsider and order a 30.8% increase in early February, an act that was to put another nail in Kriangsak's already well-sealed political coffin.

The rate of increase was carefully calculated, representing almost exactly the subsidy the government paid out of the near-exhausted oil fund to supply EGAT bunker and diesel fuel below world market prices.

While that still left EGAT in the red, Kasame went to Washington in April to persuade the World Bank to end its freeze, arguing successfully that the increase was as much as could be expected for a developing country at one time. The Prem Tinsulanond government, apparently feeling on secure political ground for the moment, lifted power rates again by 15.6% on October 1 and said there could be a further rise in a move to get EGAT back on to an even financial keel.

The latest price rise came on the day Kasame left for Australia to inspect the coalfields that will play an ever-increasing role in meeting Thailand's energy needs – not so much in making savings now, but in reducing the cost of future growth.

TARIFFS

A crack at the car market

Singapore is considering a preference scheme for the motor industry, which could mean cheaper vehicle prices

By Susumu Awanohara

Singapore: The government is proposing an unusual and potentially tricky form of tariff preferences to encourage the manufacture of car parts and components here. This is one of the priority industries identified to spearhead the "second industrial revolution" and to upgrade the republic's manufacturing activities.

Although the unpublicised tariff scheme does not appear to threaten directly Singapore's participation in the mooted Asean car complementation scheme (whereby member countries would jointly manufacture an Asean car), it could cause retaliation by other Asean states, possibly by similar devices, if Singapore appears to be attracting more than its fair share of component manufacturing.

Also, the proposal may raise some sceptical Asean eyebrows, particularly surfacing as it does so soon after the Asean industry ministers' meeting in Bali at which the grouping's own motor industry package received a distinct nudge forward (REVIEW, Oct. 10). However, the ministers also accepted the concept that individual Asean projects need not necessarily involve all five countries – though this must still be ratified later by Asean economic ministers.

The Singapore move involves a reduction in the high rate of tariffs which Singapore levies on imported cars, provided the car makers agree to set up part and component manufacturing operations here. The tariff cut could be 10-20% over five years. Car imports currently pay duty of around 45%.

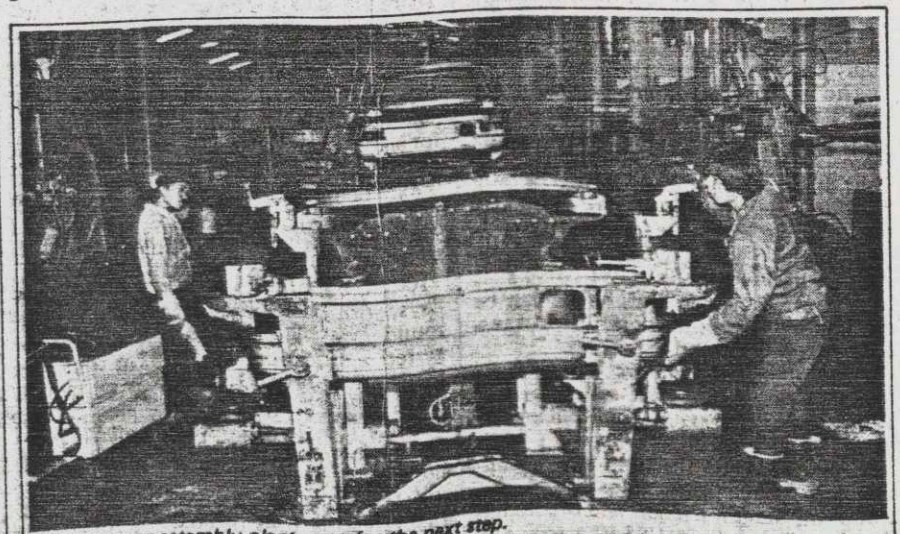
The idea appears to be that Singapore should plug into the expanding grid of international car manufacture. With the global car concept – one model being manufactured in various countries – taking hold and multiple sourcing of components becoming essential to feed such operations, Singapore hopes to serve as a supply base. But some fear the discriminatory method of attracting such investments, and the problem of deciding how to link tariff preferences to the size of investment, may make the plan unwieldy, if not unworkable.

The scheme, though officially unannounced, came to light when the local general manager of the Ford Motor Co. recently announced his group's intention to establish component manufacturing facilities in Singapore – and the fact that tariff concessions would be granted in return. The fact that this is part of a wider government strategy was subsequently confirmed to the REVIEW by official sources.

Until about a year ago, Singapore, like other Asean members, tried to encourage the domestic assembly of cars. The method used to encourage domestic assembly was the standard one of allowing the entry of knocked-down car units at low tariffs while a higher rate was levied on imports of completed cars. It was hoped that assemblers would then set up local manufacture of parts and components, and thus transfer technology to Singapore and help upgrade its workforce.

When this strategy was seen not to work, the government switched tack and (with one year's notice) withdrew duty concessions from the car assemblers as from August 1 this year. All assembly activity – carried on principally by Ford, British Leyland and Mercedes – has since ceased.

The government continued to flirt with the idea of bringing into Singapore



Singapore car assembly plant: now for the next step.

ANNEX B

From Coal Development Potential and Prospects in the Developing Countries (World Bank; October 1979)

SUMMARY

i. World prospects for coal production have recently improved considerably. During the past three decades, until the oil price increases of 1973/74, there was an apparently irreversible tendency for oil to replace coal in many uses. Coal's contribution to meeting the world's primary energy requirements fell from about 49% in 1960 to 29% in 1973.

ii. Coal constitutes a very important energy potential. World coal reserves which are exploitable with present technologies and at current prices are nearly five times larger than known oil reserves. Geological coal resources are many times more extensive. While coal is found in many places, 97% of presently known coal deposits are concentrated in developed and centrally planned economies. But there has been little coal exploration in developing countries and their basic geological data is inadequate. Comprehensive geological surveys and coal exploration programs in LDCs may well increase their known coal reserves substantially.

iii. In 1977, world coal production in terms of heat value equivalent reached about 60% of oil production. Coal output in developing countries represented 6.3% of total world coal production in that year. Some 50 developing countries have known coal resources and about 30 of these produce coal; India accounts for more than half and Yugoslavia, the Republic of Korea and Turkey for much of the rest. The lack of coal mining experience in other developing countries that have coal reserves will make it difficult to increase their output rapidly. World coal production is expected to increase at an average annual rate of about 4.2% through the 1980s, a considerable increase over growth in the previous two decades. Coal output in developing countries is expected to increase at more than 7% annually, and LDCs' share in world coal production will become more important, rising from the 6.3% in 1977 to about 9% in 1990.

iv. Coal prices have risen substantially since 1973/74, although much less than oil prices. In terms of heat value, coal is considerably cheaper than oil. But coal is difficult and expensive to distribute, particularly to small users, and the need to burn it in an environmentally acceptable manner makes it less convenient to use. Nevertheless, the prospects of a resurgence in coal use have been further enhanced by the increasing cost of other sources of energy, the delays in nuclear power programs and the anticipated depletion of oil and natural gas supplies.

v. However, coal production in LDCs is not responsive to changes in relative energy prices in the short term. Many coal bodies need additional drilling and feasibility work before investment decisions can be made. Most

developing countries also lack the infrastructure to utilize coal deposits that would be exploitable in industrial nations. The risks and high capital expenditures involved in coal mine development and uncertainties of marketing opportunities mean that few coal deposits in developing countries have appeared attractive to investors. Nevertheless, the various constraints that presently retard accelerated coal production growth in developing countries can be overcome by a more systematic approach to longer-term coal development and overall energy planning in LDCs.

vi. A strategy aimed at a more rapid coal development in LDCs must be designed to increase production while ensuring that coal demand rises in line with coal supply. Most developing countries have at this time neither the human and financial resources nor the technical know-how to launch major coal development programs. Thus international, regional and bilateral agencies as well as private mining companies have a major role to play in helping developing countries survey their coal potential, analyze the part coal may play in the energy supply balance of each country and provide financial and technical support for the implementation of coal projects.

vii. If the projected LDC coal output growth is to come about, the Bank must play an active role in (i) building up new institutions and technically and financially viable companies needed for all stages of coal development, and (ii) mobilizing capital for coal development at appropriate terms. Under its present lending program, the Bank should be able, particularly if joined in this effort by other regional and bilateral lending institutions, to assist in a substantial number of developments that might not otherwise take place. Assuming that during the 1980s the Bank will, as foreseen for the FY79-83 period, make loans for coal development totalling US$100-200 million per year in real terms, the Bank would be associated with coal projects totalling US$3.3 - 6.6 billion, or some 17-35% of expected investments in coal mining and associated transport projects in developing countries through 1990.

viii. The attempt to accelerate coal production in developing countries cannot succeed in isolation and will depend to a considerable degree on policy decisions made by developed countries. An increased emphasis on use of coal as an energy source in industrialized nations could (i) increase demand for LDC coal, particularly in countries which are short of low-cost coal, (i.e., Western Europe and Japan), and (ii) stimulate more research in industrialized nations on technologies for coal exploration, mining, processing, handling and transport, all of which could assist LDCs in the development of their coal potential.

ANNEX C

Woodfuel Problems of Developing Countries

Introduction

The energy needs of Developing Countries fall into two principal categories - (a) non-commercial energy principally woodfuel for cooking, and (b) modern sector fuels for transport, electric power and industry.

As much as 90% of the energy used in many countries is woodfuel and dung for cooking. Depletion of woodfuel especially in dry regions is requiring increasing time by women and children to gather it to meet family cooking fuel needs in rural areas. Demand for woodfuel for charcoal in the region of mushrooming cities is severely stressing woodfuel regeneration capacity. Resulting soil erosion is destroying woodfuel regenerative capacity, contributing to flooding, etc.

Some recent studies reflect a rising awareness of the severity of these problems and the long lead-times and large scale, sustained reforestation programs needed to arrest fuelwood depletion and to generate increasing amounts to meet the needs of an increasing population. Fuel for cooking is as essential as food for the survival of people.

This memorandum is a brief review of some features of the woodfuel/charcoal situation, the inadequacy of most of the technical fixes which have been receiving publicity as solutions for LDC energy problems, some obstacles to the substitution of coal for charcoal, the need for use of simple coal stoves, and the importance of the use of coal in modern sectors so that it will be available at such time as charcoal becomes so expensive that people will switch to coal for cooking. I am much indebted to Gerald Foley and Ariane van Buren of IIED, London, for sharing with me their report to the FAO Forestry Division, "Coal Substitution and Other Approaches to Easing the Pressure on Woodfuel Resources - Case Studies in Senegal and Tanzania" December 1980, and to papers from the meeting of the Technical Panel on Firewood and Charcoal (FAO January 1980), and to Worldwatch Paper #26 by Erik Eckholm on Forestry for Human Needs - February 1979, etc.

A. The Present Position

1. Non-Commercial Energy

Half or more of the energy needs of most OIDC's (50% for India, 90% for Tanzania) are for fuel for cooking (a requirement for survival). Fuelwood in rural areas is largely outside the money economy being gathered by women and children. In many areas demand exceeds regeneration rate resulting in deforestation, soil erosion, flooding, etc. In an expanding area around cities wood is disappearing as demand for woodfuel for charcoal for urban use is added to the demand for such wood for rural use. In some urban areas where charcoal is marketed as much as 30% of a family's budget is required for cooking fuel. Rising population and exploding cities will accentuate all these pressures.

2. Woodfuel and Charcoal for Cooking

Although there is little reliable data, it is estimated that as much as 90% of the energy used in many LDC's is wood for cooking and as a free good it is outside the commercial sector. Use per person is $\sim$ 1.5 m^3/year. It is probable that serious problems of woodfuel depletion will arise in many LDC's before the year 2000 as a result of rising population and declining woodfuel regeneration in many places.

3. Woodfuel Regeneration

The most certain and socially acceptable way to meet these problems is to increase woodfuel output by reforestation. However, severe problems arise in the planting, cultivation and protection until maturity of trees planted for firewood. To supply urban needs it will be necessary to have commercial forests whose output as woodfuel or charcoal would enter the commercial sector as charcoal now does. Wood for charcoal should be hardwood and lead times for growing trees to maturity are long.

Annex 1 is a table from the first meeting of the Technical Panel on Fuelwood and Charcoal (Forestry Division, FAO, January 1980). It shows the rural afforestation programs needed in selected LDC's in order to meet fuelwood requirements in 2000. It indicates that present planting rates would have to be increased more than ten-fold on the average.

4. Scales of Future Woodfuel Demand

To meet the requirements for 1 billion people for woodfuel at 1 m^3/cap. would require 1 billion m^3/year annually from forests. In some tropical countries woodfuel generation may be 4-5 m^3/ha/year. In drier places it may be as low as 1 m^3/ha/year. Perhaps 2 billion people now rely on woodfuel and this number may grow to 3-4 billion by the year 2000. At a generation rate of 2 m^3/ha, 4 billion people would need the woodfuel output of 2 million km^2 of forest. The actual figure may be substantially larger. Moreover, the conflict over land for growing fuel or food is very real in most developing countries. If the wood is obtained from typical natural high forest the area required ranges from 0.3 to 1.0 ha per capita on a sustained yield basis.

5. Past Coal Use in LDC's

Before the recent and brief era of cheap and abundant oil coal was used in many OIDC's for railways, electric power, cement, breweries, pulp and paper, smelters and other uses in the modern sector. In many cases such coal was imported. For example, British coal exports to French and Equatorial Africa were 149,000 tons in 1913 and 68,000 tons in 1946. Some electric power plants and cement plants in OIDC's originally used coal before conversion to oil within the past 20 years. Thus in many countries there is some history of coal importation and use and coal mining and use in others. There is little evidence that coal was used in the past for cooking in such countries. A number of ports have bulk handling equipment which could handle coal imports. Distribution to wholesale or retail merchants occurred in the past and could develop again if a demand existed.

6. Coal as Cooking Fuels

In the industrialized countries coal was the principal fuel for cooking for more than a century until after World War II. Coal replaced wood and charcoal as they became depleted. It

was burned in stoves with suitable chimneys permitting safe use inside houses. In China and parts of India in coal mining districts coal is now used for cooking in communes and villages. Using available coal dust families make briquettes of coal dust and clay and cooking is usually done outdoors thereby avoiding CO problems. However, it is much less convenient to use than charcoal. It requires at least a simple stove to sustain combustion and that costs money. Moreover, charcoal is much preferred for the taste it imports to cooked meats.

7. Petroleum Products

Substitution of kerosene and LPG products for charcoal aggravates the already crushing burden of payments for imported oil. For families in rural areas (over 2 billion or half the world's population) purchase of petroleum products whose price is rising is wholly beyond their means.

8. Proposed Technical Fixes

A number of technical fixes have been proposed for the energy needs of LDC's - solar cookers, biogas digesters, solar pumps, solar-electric systems, windmills, etc.

It is necessary to consider overall efficiencies - energy content of the fuel into heat "in the pot." The simple three-stove form for burning woodfuel is very inefficient. Charcoal stoves are somewhat better. Kerosene and LPG stoves can be very efficient. Thus, kerosene and LPG may be used 3-4 times more efficiently than charcoal and justify such a price difference.

Only two - solar cookers and biogas - relate directly to cooking fuel. Solar cookers have been available for 20 years and have not been a success on a large scale anywhere in the world. Cooking in the middle of the day does not fit most cultural patterns. Biogas as developed in China has become very important in only one province of China (Sichuan). The technology of construction of gas-tight digesters and their operation to produce methane and fertilizer is not at all simple. It is complex biological engineering. Use of biogas digesters has not yet spread very widely in the rest of China nor in other countries.

All the other technical fixes involve expensive, capital intensive technology. Although they may in due course furnish additional energy supplies in impoverished rural areas, they do nothing to ease the pressure on woodfuel nor are they related to the scale and urgency of the problem.

Table from Papers for First Meeting, Technical Panel on Fuelwood and Charcoal, FAO - Rome January 1980

COMPARISON OF CURRENT ANNUAL RURAL AFFORESTATION PROGRAMS IN SELECTED DEVELOPING COUNTRIES WITH THE APPROXIMATE SIZE OF PROGRAM NEEDED TO MEET DOMESTIC FUELWOOD REQUIREMENTS TO THE YEAR 2000

Country	Current Annual Afforestation Program	Approximate Annual Program needed to meet domestic fuelwood requirements to the year 2000	Total Planting Target needed by the year 2000 to meet domestic requirements	Factor indicating by how much the present annual rate of planting would have to be increased to meet domestic requirements to the year 2000
	(000's of ha)	(000's of ha) 1/	(million ha)	
Rwanda	1.5	13.0	0.26	8.6
Burundi	1.5	5.4	0.11	3.6
Malawi	2.5	13.0	0.26	5.2
Tanzania	2.5	20.0	0.40	8.0
Sierra Leone	0.5	2.5	0.05	5.0
Niger	0.5	3.5	0.07	7.0
Mali	0.5	4.0	0.08	8.0
Nigeria	10.0	100.0	2.00	10.0
Ethiopia	1.0	50.0	1.00	50.0
Nepal	5.0	50.0	1.00	10.0
Thailand	10.0	75.0	1.50	7.5
India	20.0	250.0	5.00	12.5
Afghanistan	1.0	50.0	1.00	50.0
Peru	5.0	20.0	0.40	4.0
Ecuador	2.0	13.0	0.26	6.5
Totals	63.5	669.4	13.39	

Source: World Bank data 1978

1/ Based on the assumption that between one third and one half of total rural energy requirements could be met by other forms of energy than wood, such as biogas plants or solar cookers and by introducing greater end use efficiency.

ANNEX 1