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Cuba: Implications of Dependence on Soviet Oil [redacted] 25X1

A Research Paper

Secret

ALA 82-10017
February 1982

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A Research Paper

Information available as of 1 December 1981 has been used in the preparation of this report.

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This paper was prepared by Office of African and Latin American Analysis and Office of Imagery Analysis. Comments and queries are welcome and may be directed to the Chief, Cuba-Caribbean Branch, ALA, on

This paper was coordinated with the National Intelligence Officer for Latin America, the Offices of Global Issues and Soviet Analysis, and the Directorate for Operations.

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Cuba: Implications of Dependence on Soviet Oil

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Overview

For Cuba, like other Third World countries, increased energy use is critical to modernization. Havana faces particular economic and political complications in the absence of primary energy sources at home and the heavy share that foreign-financed oil takes up in its import bill and development costs.

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The Cuban economy has become almost totally dependent upon Soviet-subsidized oil deliveries. This condition—which gives Moscow strong leverage on the Castro regime—is likely to continue at least to the end of this century.

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Soviet-supplied petroleum provides more than 75 percent of the island's total energy consumption. Cuba has no large oil deposits and little hope of finding any; domestic production amounts to less than 5 percent of total petroleum requirements.

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Havana has no realistic source of subsidized imports other than the USSR. Despite Cuba's good relations with several oil-producing countries, none is likely to match the Soviet price, which in 1980 was only about 40 percent of average OPEC crude prices. Although Moscow apparently intends to increase moderately the amount of oil it supplies to Cuba over the next five years, deliveries probably will fall short of Havana's needs for meeting its growth targets.

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The Castro regime, moreover, cannot afford to purchase substantial amounts of oil on the world market. Cuba's estimated total hard currency earnings for 1981 would be sufficient to finance only half of its current oil consumption.

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Other possible energy sources have little promise. The island's only significant nonpetroleum energy source, bagasse—a byproduct of sugarcane—provides about 18 percent of Cuba's energy needs, but because of its bulk it can be used only in sugar-harvest activities. There is no hydroelectric potential, minimal coal deposits, or other energy source with short-term potential.

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Long-term approaches such as gasohol or coal-oil mixtures are feasible but could not become effective before the 1990s and would only moderately reduce the country's oil dependence. Even the construction of nuclear power plants—preliminary work on one began earlier this year—would not have a significant impact during this century.

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Cuba's dependence on the USSR for its petroleum is aggravated by the nonconsumer orientation of Havana's economy. Even a 10-percent reduction in petroleum supplies would reduce economic activity. This vulnerability is increased by limited oil-storage capacity; the island's storage tanks can hold only a two-month supply, making stockpiling for long-term contingencies nearly impossible.

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The Castro regime has little hope of achieving sustained economic growth during the 1980s and possibly longer. Future economic expansion requires not only the continuation of subsidized petroleum imports, but a steady increase in the amount of those imports. Industrial growth and electric-power generation are the most vulnerable. Havana's efforts to expand its import substitution industries and construction sector also are likely to experience setbacks. Overall agricultural production will not be affected seriously, but plans for increased agricultural mechanization may have to be postponed.

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In the interim, the already weak economy would be hard hit by a major shortfall in petroleum deliveries no matter what the cause. Lacking any meaningful conservation options, a petroleum shortage would force Cuba to curtail economic activity. In severe shortages or a total cutoff, the island could operate at reduced economic activity for perhaps two months by stretching out reserves. Over a longer period, however, modern economic activity would virtually cease and the nation would concentrate on subsistence.

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The Castro regime's dependence on Soviet-subsidized oil also provides Moscow with what amounts to substantial leverage that can be exerted on major Cuban foreign policy decisions. Soviet influence on both internal and external matters is so great that Castro has cautioned fellow revolutionary chiefs of state to avoid policies that would lead to such dependency on the USSR. At the same time, the Cuban leader is obliged to seek new ways to ingratiate himself with Moscow to extract even greater levels of economic assistance to stay abreast of mounting Cuban needs. His support for the Warsaw Pact's invasion of Czechoslovakia in 1968, his somewhat belated backing of the Soviet invasion of Afghanistan in 1979, and his justification last year for East European intervention—if needed—in Poland are examples of how the need for Moscow's approval has cost Castro heavily in political terms.

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At the same time, Soviet subsidies are offset by the role Castro plays in supporting Moscow's objectives in the Third World. Castro undoubtedly will continue providing support for revolutionary insurgent movements in Latin America and Africa. He also will continue providing military support to leftist governments such as Angola, Ethiopia, and Nicaragua. If necessary, he would be willing to increase the Cuban commitment to these regimes. The Cuban leader recognizes that, by virtue of his Third World credentials, he can often accomplish some of the objectives he shares with Moscow more easily than the Soviets themselves. [redacted] 25

He will also persist in his decade-long drive to expand Cuba's international contacts and influence, focusing particularly on oil-producing countries, partly to serve Soviet designs and partly to develop contacts that could prove useful should Soviet oil supplies be reduced. His relationship with Moscow, of course, dictates that there be no amicable relationship with the United States and this—if Castro's own bitterly anti-US predisposition were not enough—means that hostility will remain the basic ingredient of the Castro regime's attitude toward Washington. [redacted] 2

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Cuba: Implications of Dependence on Soviet Oil

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Cuba's Energy Dilemma

Cuba's lack of domestic energy resources has made the Castro regime extremely dependent on Soviet oil deliveries—a situation from which there is no obvious escape. Imported petroleum—all which is subsidized by the USSR, accounts for more than 75 percent of Cuba's total energy consumption. The subsidies have enabled Cuba to increase its consumption of petroleum without the severe dislocations experienced by other oil-importing-developing countries (LDCs). Cuba's economic fate—although subject to other factors as well—will be determined largely by whether these concessionary prices are continued.

Limited by low hard currency reserves, Havana could not maintain current oil-import levels if forced to pay average OPEC prices. For example, Cuba's entire 1981 estimated hard currency earnings would finance only half of its oil imports. Moreover, this condition will worsen during the next five years. The economic targets set by the leadership for 1981-85 cannot be met unless oil deliveries reach at least 13.6 million tons in 1985—about a 25-percent increase over 1980 deliveries.

The Castro regime is well aware of its vulnerability. In a speech in mid-1980, the Cuban leader pointedly noted that it would be difficult for a country without petroleum to survive a naval blockade. Even a slight decrease in Soviet deliveries would quickly cause shortages in Cuba. Because of Cuba's lack of any meaningful conservation options, a petroleum shortage as small as 10 percent would force decreased economic activity.

The Castro regime has placed a high priority on finding domestic oil, but despite considerable efforts production still represents less than 3 percent of total petroleum requirements.

Cuba's oil vulnerability is increased by its limited refining capacity and storage facilities.

no significant increases in refining capacity will occur until another refinery under construction becomes operational in 1985-86. In addition, the island's storage tanks hold only about a two-month supply, making stockpiling for long-term contingencies nearly impossible.

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Cuba's only significant domestic nonpetroleum source of energy is bagasse, a byproduct of sugarcane. In 1980 this substance provided 18 percent of energy supplies, but, because of prohibitive transportation costs, it can be used only in sugar-harvest activities. Its relative importance over the long term will continue to decrease as energy demand increases and sugar output remains relatively stable.

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Other potential sources hold little or no promise. Cuba has:

- No additional hydroelectric potential.
- No significant coal deposits.
- Only small supplies of charcoal and fuelwood.
- Substantial deposits of peat, but exploitation costs are prohibitive.
- Limited applications of solar energy because home heating requirements are minimal.

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A few options have long-run potential for moderately decreased petroleum dependence. Approaches such as coal-oil mixtures and gasohol are technically feasible, but conversion costs could not be fully recovered until some time in the 1990s.

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Nuclear power offers little potential before the 21st century. A Soviet-sponsored nuclear project, in the planning and survey stages in Cuba for seven years, is not likely to be operational during this decade. Its completion will enable Cuba to lessen its dependence on oil imports by less than 10 percent. If more nuclear

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power projects are eventually built, Cuba would then be dependent on imported uranium—albeit less costly at current prices than the energy equivalent of imported oil.

Growth in Energy Demand. Energy demand in Cuba since the revolution has increased more than 165 percent—from 107,000 barrels per day (b/d) oil equivalent in 1957 to 286,000 b/d in 1980. The increase reflects:

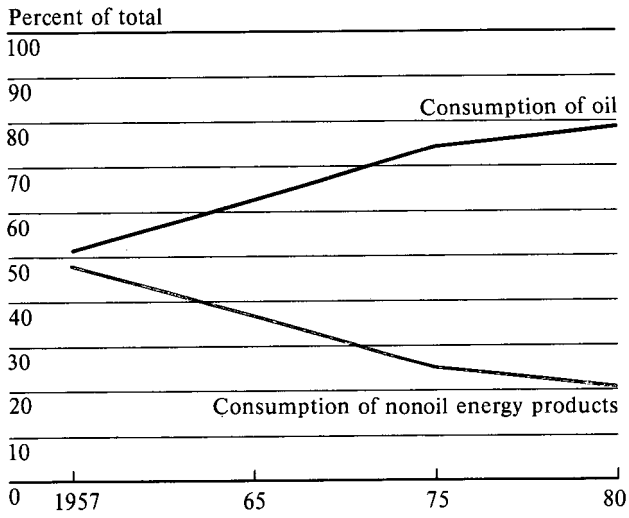
- An overall growth in economic activity.
- The Castro regime's emphasis on expansion of the industrial and transportation sectors.
- The mechanization of agriculture.
- A growth in population of almost 50 percent.
- A general improvement in social services.

Table 1 shows the dramatic shift in consumption patterns since Fidel Castro assumed power. The industrial sector, which consumed energy at less than half the rate of the agricultural sector in 1957, has become the single largest consumer. During the 1957-80 period, the industrial sector more than quadrupled its rate of energy consumption. This rapid expansion reflects the creation of numerous agricultural-associated industries, efforts to develop substitutes for some imported products, and Castro's desire to acquire some of the heavy industrial facilities that symbolize modern development.

Energy consumption in the household sector also increased sharply during the period. Much of this expansion resulted from increased availability of electricity to private homes (particularly in rural areas). The increase in consumption by the military sector resulted from the expansion and modernization of the armed forces initiated by Castro immediately after he took power. The increase in consumption by the transportation sector was also rapid.

In contrast, the agricultural sector showed a sharp decrease in relative energy consumption, from one-half of total energy consumption in 1957 to only about one-fourth in 1980. The change resulted primarily from the much faster growth rate in industrial consumption. Most of the increased consumption by the agricultural sector resulted from the mechanization of sugar-harvesting activities.

Figure 1
Relative Energy Consumption in Cuba, 1957-80



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Dependence on Petroleum. The growth in energy demand has been met almost totally by imported petroleum, which has grown from one-half of total energy supplies in 1957 to more than three-fourths in 1980 (see table 2 and figure 1). While the quantity of other energy sources has increased only about 13 percent since 1957, imports of petroleum have quadrupled. This increase is the result of a conscious decision made during the 1960s to take advantage of low petroleum prices. Lacking any significant domestic alternative source, Cuba had no other realistic choice. Despite sharp increases in world petroleum prices, subsidized Soviet oil supplies enabled Havana to increase further its petroleum consumption. The availability and price of Soviet oil has buffered the Cuban economy from the severe problems experienced by other oil-importing LDCs. As a consequence, however, Cuba's economic future hinges on Soviet oil policy. Even a modest reduction in quantity or an increase in price could have a serious impact.

Table 1

Estimated Final Sector Energy Consumption [a]

	1957		1980		1985 [b]	
	(Barrels per day oil equivalent)	(Percent)	(Barrels per day oil equivalent)	(Percent)	(Barrels per day oil equivalent)	(Percent)
Total consumption	**107,000**	**100.0**	**286,282**	**100.0**	**369,873**	**100.0**
Agriculture	54,571	51.0	74,947	26.2	105,677	28.6
Sugar	50,685	47.4	62,545	21.9	91,979	24.9
Bagasse [c]	49,220	46.0	50,336	17.6	74,025	20.0
Oil	1,465	1.4	12,209	4.3	17,954	4.9
Other agriculture	3,886	3.6	12,402	4.3	13,698	3.7
Industry	23,540	22.0	98,427	34.4	126,233	34.1
Nickel [d]	NA	NA	15,263	5.3	27,713	7.5
Electric power [e]	NA	NA	7,565	2.6	11,468	3.1
Other [f]	NA	NA	75,599	26.4	87,052	23.5
Transportation [g]	22,470	21.0	70,970	24.8	81,616	22.1
Household [h]	4,280	4.0	34,912	12.2	47,339	12.8
Military	302	0.3	4,468	1.5	5,479	1.5
Other [i]	1,838	1.7	2,558	0.9	3,529	1.0

[a] Because of rounding, components may not add to totals shown.
[b] Estimates are based on the amounts needed to achieve the economic targets set for 1985.
[c] Assuming that bagasse to milled cane ratio is 25 percent, that 90 percent of available bagasse is used as fuel by the sugar industry, and that the moisture content of bagasse is 50 percent.
[d] Assuming that 20 tons of petroleum are consumed in the production of 1 ton of nickel.
[e] Assuming that 285 tons of oil are consumed per million kilowatt-hours generated, and that 15 percent of generation is lost internally and through transmission.
[f] Other heavy users include: citrus, cement, and construction industries.
[g] Assuming this sector consumes all gasoline, diesel, jet fuel and aviation gasoline (except that portion which is reported to be imported by the military). Although the agricultural sector consumes some of the diesel fuel for crop transportation and the military sector consumes some gasoline and diesel fuel, there is no data available to quantify these amounts.
[h] Assuming this sector consumes all available kerosene, fuelwood, and charcoal, and 30 percent of the electricity generated.
[i] Including consumption of electrical power by state ministries, schools, hospitals, etc. and assuming that these sectors consume 5 percent of generated electricity.

Table 2

Estimated Energy Supply [a]

	1957		1980		1985 [b]	
	(Barrels per day oil equivalent)	(Percent)	(Barrels per day oil equivalent)	(Percent)	(Barrels per day oil equivalent)	(Percent)
Total	**107,000**	**100.0**	**286,282**	**100.0**	**369,873**	**100.0**
Imports	**54,221**	**50.7**	**222,162**	**77.6**	**283,286**	**76.6**
Total oil	53,258	49.8	220,192	76.9	281,316	76.1
Crude oil	27,694	25.9	132,543	46.3	NA	NA
Oil products	25,564	23.9	87,649	30.6	NA	NA
Coal and coke	963	0.9	1,970	0.7	1,970	0.5
Domestic production	**52,780**	**49.3**	**64,120**	**22.4**	**86,587**	**23.4**
Oil	522	0.5	5,800	2.0	7,411	2.0
Hydroelectricity	335	0.3	1,204	0.4	1,204	0.3
Natural gas	0	0	333	0.1	500	0.1
Ethyl alcohol	1,205	1.1	704	0.3	704	0.2
Bagasse	49,113	45.9	50,336	17.6	71,025	19.2
Fuelwood/charcoal	1,605	1.5	5,743	2.0	5,743	1.6

[a] Because of rounding, components may not add to totals shown.
[b] Estimates of oil imports based on what would be needed to accomplish goals set in the five-year plan for 1985. Estimate for bagasse based on Cuba meeting its 10-million-ton sugar goal in 1985.

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Although the cost of Soviet oil has risen steadily since 1975, prices remain only about one-half the average OPEC crude oil price (see table 3). The subsidy rate is based on an average of the world price for the previous five years. Even with this subsidy, Cuba's expenditures for oil have tripled between 1975 and 1980. [redacted] 25X

These price breaks are becoming increasingly expensive for Moscow. In 1980 foregone hard currency earnings resulting from the petroleum subsidies granted to Cuba were equivalent to more than 5 percent of actual Soviet hard currency earnings. [redacted] 25X

In recent years the Soviets have begun to cut their costs by decreasing oil transportation expenses. For example, since 1978, Moscow has pursued a number of swap arrangements with third parties. Cuba receives about 10,000 b/d of crude from Venezuela under a quadripartite arrangement whereby Venezuela and the Soviet Union switch trading partners—Venezuela delivers to Cuba and the Soviet Union delivers to Spain. Cuba also receives fuel oil and products from Curacao, and fuel oil from France, both on the Soviet account at subsidized prices. Possible future arrangements call for another oil swap between Cuba, Mexico, the USSR, and one of Mexico's European customers, probably Spain, and for a Swiss firm to provide Cuba with crude from Curacao. [redacted] 25X

Increasing Energy Requirements. The 1980 Soviet-Cuban trade protocol called for Soviet deliveries to Cuba of 11.1 million metric tons (about 220,000 b/d) of oil and products in 1980, and, although no official data have been released, Cuba probably received this amount. [redacted] 25X 25X

Table 3

Cuba: Crude Oil and Product Imports From the USSR

	1975	1976	1977	1978	1979	1980	1981 [a]
Imports							
(Thousand metric tons)	7,812	8,240	9,245	9,500	9,600	11,116	11,500
(Million US $)	332	356	510	715	778	1,035	1,408
Average OPEC crude price [b]							
(US $ per metric ton)	80.78	86.27	94.41	94.78	136.85	226.28	249.22
Soviet price to Cuba							
(US $ per metric ton)	42.49	43.22	55.12	75.26	81.03	93.08	122.41
Soviet subsidy [c]							
(US $ per metric ton)	38.29	43.05	39.29	19.52	55.82	133.20	126.79
(Million US $)	299	355	363	185	536	1,481	1,458

[a] Estimated.
[b] F.o.b. prices set by the government for direct sales and, in most cases, for the producing company buy-back oil. Weighted by the volume of production.
[c] This subsidy has been measured by taking the difference between Soviet prices to Cuba and average OPEC crude prices. Because the USSR exports both crude oil and products, measuring the difference between Soviet prices and average OPEC prices probably understates the true value of the subsidy.

[redacted] 25

Cuba's petroleum needs, however, will grow substantially during the next five years. The five-year plan for 1981-85 calls for a major expansion of the industrial sector and in electric-power generation. Castro claimed in December 1979 that Soviets had "guaranteed" delivery of 61 million metric tons over the period. In a subsequent speech, however, Castro indicated that fuel imports are expected to increase 10 to 15 percent during the current five-year plan, to a total of 53-55 million metric tons. The decline in Castro's expectations could mean that Moscow has reduced planned fuel deliveries to Cuba because of:

- Prospects of stagnating Soviet oil production over the 1981-85 period.

- Concern that East European importers of oil who have been told not to expect any significant increase in Soviet oil exports during the 1980s (East Germany has already experienced cutbacks in planned deliveries) would be angered by an increase of shipments to Cuba.

- The increasing hard currency cost to the USSR of maintaining a high level of subsidized oil exports. [redacted]

Cuba will need at least 13.6 million tons of oil in 1985 to meet targets set in the five-year plan—well above the average annual delivery of 10.5-11 million tons that were promised.[1] For example, the planned 50 percent expansion in electric-power generation will require about 1.5 million tons more oil than used in 1980. To support increased nickel production as planned, oil imports must grow by more than 600,000 tons. Planned increases in sugar output will require another 285,000 tons. An additional 100,000 tons will be needed to meet the demands of normal population growth. [redacted] 25X 25

[1] Energy needs are based on the following consumption rates: 1 gallon of oil per ton of cane ground, 20 tons of oil per ton of nickel produced, and 285 tons of oil per million kilowatt-hours of electricity generated (these are 1980 consumption rates). [redacted] 25

Havana has no alternative to the USSR as a source of subsidized oil imports. Castro has worked hard to develop good relations with several oil-producing countries (Mexico, Libya, and Iraq). Each may be willing to export oil to Cuba, but none is likely to match Moscow's subsidized prices.

Havana could not maintain current import levels if it were forced to pay the world price. Its ability to borrow abroad for this purpose is limited, and its hard currency export earnings will not be sufficient to finance oil-import needs. Cuba's estimated 1981 hard currency earnings would finance only half of the nation's consumption of petroleum at the average OPEC crude price.

Development of Domestic Resources [2]

Oil Exploration. The Castro regime has devoted considerable effort to finding oil, but present domestic production, at less than 6,000 b/d, represents less than 3 percent of total oil supplies.

Although some small to medium reservoirs (up to 200 million barrels) may exist off the northern coast of the island, exploitation of such reserves would require state-of-the-art US technology. Even with highly advanced drilling procedures, however, Cuba has little hope of finding significant oil deposits during the next five years, if ever.

Nonpetroleum Energy Sources. Even over the long term, Cuba has little hope of reducing its need for oil. A full-scale effort to utilize all feasible alternatives would have little impact before the year 2000. Other than bagasse, a byproduct of sugarcane milling, Cuba currently has no significant alternative sources of energy.[3] In 1980 this substance provided an estimated 18 percent of total energy supplies. Its use as a fuel, however, is limited almost exclusively to the sugar mills, because its bulk and low caloric content make it difficult and uneconomic to transport.

Ethanol—manufactured from the residual syrup (molasses) obtained during the processing of sugarcane—could be used as an alternative source, but would require significant capital investment. Even with a maximum effort, however, Havana could realize a savings of less than 2 percent of total energy requirements. 25X1 25X

Cuba possesses no known anthracite or bituminous coal deposits. Some deposits of lignite coal have been discovered, but these are small, and, therefore, uneconomical to develop. Rising coal prices caused sugar mills and other major coal users to convert to oil in the 1940s and what little coal is used today is imported from the USSR. 25X1 25X

One possible alternative would be conversion to a coal/oil mix in thermalelectric power plants. Such an approach could produce a total petroleum savings of 8 to 10 percent, but would require relatively large capital expenditures. 25X1 25X

Cuba's large deposits of peat offer little potential as an alternative energy source. The principal obstacle is that of high costs associated with extraction. Some fuelwood and charcoal are produced for use as home cooking fuel, but this amount has been steadily decreasing since the late 1930s, and now represents only 2 percent of energy consumption. There is almost no potential for increased use of these fuels. Hydroelectricity production accounts for less than 1 percent of energy consumption because Cuba's hydroelectric resources are limited. Most rivers are short, narrow, and shallow. 25X 25X

Nuclear energy offers the principal means by which Cuba can lessen its dependence on oil. A Soviet-sponsored nuclear power project has been in the planning and survey stages in Cuba since 1974, but preparations for construction did not begin until this year. Even if large-scale construction of the facility begins immediately, it would not be operational until the late 1980s at the earliest. This schedule is not likely to be met, however, and it is unlikely that Cuba's nuclear power station will be operational before the early 1990s. 25X 25X

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[2] For a more detailed account of domestic and nonoil energy sources, see annex.

[3] Bagasse is a moist, fibrous mass consisting of ground stalks and leaves, which are byproducts from the milling of sugarcane. It has a relatively low caloric value—1 ton of bagasse is equivalent to only 0.18 ton of crude petroleum.

Even with nuclear power, Cuba's dependence on Moscow as an energy supplier will not be significantly decreased since Cuba has no known deposits of uranium. All the necessary uranium will probably be obtained from the USSR, which has vast sources of the mineral. Another possible supplier is Namibia, which also has considerable deposits of uranium; Cuba—with its presence in neighboring Angola—is a strong supporter of the guerrilla struggle against South Africa's hold on Namibia.

Soviet-sponsored nuclear power projects represent an attractive alternative to the increasing cost and possible decreasing supplies of Soviet oil. It is likely, therefore, that Cuba will seek one or two additional nuclear generating facilities.

Refining and Storage Facilities. At present there are only three oil refineries in Cuba, with a combined production of about 138,000 b/d. Despite considerable expansion, the capacity of these refineries has not kept pace with the surge of imported petroleum, especially in recent years. Between 1975 and 1980 imports of refined oil products increased by 121 percent, while imports of crude increased by only 13 percent.

Efforts are under way, however, to reduce imports of refined products. Modernization and expansion of the two largest existing refineries is continuing. Construction of a fourth refinery, in Cienfuegos, has recently begun.

Cuba's dependence on steady oil imports is increased by its limited petroleum storage facilities. Although storage capacity has increased by about 18 percent since 1975, there are still only 11 sizable storage sites on the island, which at capacity hold only about 20 percent of annual petroleum requirements—just over a two-month supply. Moreover, the two largest sites—at the refineries in Havana and Santiago de Cuba—constitute over half of Cuba's total petroleum storage capacity. A major breakdown at either of the two principal sites could thus seriously affect the economy.

No reliable information is available concerning the amount of petroleum reserves on the island, but estimates have ranged from a low of four to five days to over a month. 25

Impact of an Oil Shortage

The already weak Cuban economy would be hit hard by a shortfall in petroleum deliveries, no matter what the reason. Cuba probably is most concerned about the possibility of a reduction in oil deliveries from the Soviet Union. Because of its own hard currency shortage, Moscow is not being as generous with its largess as in the past. 25

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it is unlikely Moscow will decrease significantly oil deliveries to Cuba. 25

A more probable alternative for Moscow would be an increase in the price it charges Cuba for oil. Moscow opted for such a course with Ethiopia recently. Currently Cuba pays a price based on the average world market price of the previous five years (see table 3). If Moscow significantly decreased this subsidy level, Cuba would be forced to decrease its consumption of oil, or decrease its consumption of other Soviet imports (many of which are basic consumer, industrial, and agricultural goods and raw materials). 25

The primary petroleum consumers—industry (44 percent) and transportation (31 percent)—would be most affected. Agriculture consumes only 11 percent as most of its energy requirements are satisfied by bagasse. The military sector would be least affected, because it consumes less than 3 percent of total petroleum supplies. During a temporary shortage the armed forces could receive small allocations from other sectors and still maintain normal levels of activity. 25

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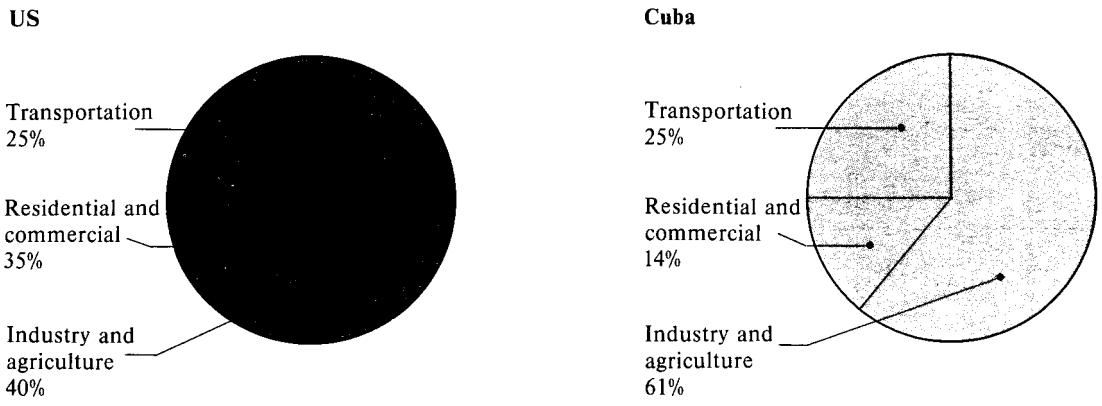
Figure 2
Comparison of Cuban and US Energy Consumption by Sector, 1980



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Although each of the major sectors is undoubtedly inefficient in its use of energy, conservation efforts offer little potential for savings during the next five years—probably not more than 5 percent. During the past five years, a major effort to reduce wasteful consumption of oil in the sugar refineries and the electric-power industry has been under way—the total savings amounted to almost 4 percent of petroleum consumption in 1980. Greater savings in these sectors requires more efficient equipment—something Cuba cannot readily obtain, given the shortages of foreign exchange. The transportation sector could also save 10 to 15 percent of its gasoline by converting to gasohol, but even this would reduce oil consumption by only 2 percent and would require several years to accomplish.

The Castro government also has initiated conservation measures directed at individual households and commercial sectors including:

- Use of more fluorescent light in homes.
- Decrease of gasoline rations.
- Increase of rates for electric power during hours of peak demand.
- Termination of illegal hookups to the electric-power system by private homes.

These sectors, however, offer little potential for a substantial reduction in energy use. With few private automobiles, domestic electric applicances, and commercial establishments, these consumers account for only 14 percent of Cuba's petroleum demand, compared with 35 percent in the United States (see figure 2). For example, even if consumption of the household sectors was decreased by 20 percent, less than 3 percent of total petroleum consumption would be saved. Because of the general nonconsumer orientation of Cuba's economy, such a reduction would have a sharp impact on an already austere lifestyle. It would, moreover, counter recent promises of greater consumer welfare.

Table 4

Cuba's Short-Term Options for a Cutback in Petroleum Deliveries

Short-Term Options [a]	Petroleum Savings [b] (Percent)	Economic Impact
Reduce household consumption by 20 to 30 percent.	2 to 3	Sharp reduction in the already austere lifestyle.
Cut transportation activity by 10 to 15 percent.	3 to 5	Virtual termination of all personal travel, increased worker absenteeism, lower labor productivity.
Reduce consumption of light industry by 5 percent.	2 to 3	Decrease in the supply of consumer goods, such as shoes, clothing, and detergents.
Stop mechanical harvesting of sugarcane.	2	Requirement for 100,000 to 140,000 additional persons to accomplish harvest.

[a] Possible Cuban response to a sudden decrease in Soviet supplies.
[b] Savings are expressed as a percent of total petroleum consumption in 1980.

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Because Cuba lacks any meaningful conservation options, a petroleum shortage would force it to curtail economic activity. With storage tanks full, Cuba would have enough oil for two months at 1980 consumption rates. If petroleum were also stored in containers in warehouses, this period would be lengthened. There is no evidence, however, that warehouse storage has begun.

In the event of modest shortages (10 to 15 percent), every attempt would be made to preserve industrial and agricultural production—particularly that which provides hard currency earnings (see table 4). Cuts would be made first in household consumption, particularly of electricity. Because this accounts for only 7 percent of petroleum consumption, however, other cuts would be necessary. The next targets for decreases would probably be light industry, nonessential public transportation, and mechanization of sugarcane harvesting. These measures could be accomplished without severely disrupting the economy, but some damage would result from reduced production and the postponement of long-term expansion efforts. In addition, public discontent would follow decreased availability of consumer products, electricity, and transportation. If such shortages were perceived as being caused by US actions, however, the majority of the population would rally behind Castro.

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In the event of severe shortages or a total cutoff, drastic measures would have to be taken. Industrial production, electric-power generation, and transportation services would be greatly reduced, eventually halted, and the economy would concentrate on production of food and goods for subsistence. Sugar production could continue in the short term, but, because of its dependence on mechanization, output would be reduced. The nation could probably manage at a reduced level of economic activity during the first two months by stretching out its petroleum stockpiles, but for a more prolonged period, modern economic activity would virtually cease.

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Annex: Domestic Energy Sources and Storage Capacity

New Energy

The Castro regime, fully aware of its energy vulnerability, has devoted considerable effort to finding new oil, but domestic production remains grossly inadequate. Commercial production, which began in 1915, provides less than 3 percent of total oil supplies (see table 2).

Cuba has nine oil-producing areas. The most productive fields are Guanabo, with 50 drilling sites, and Jatibonico with 100 sites (see figure 3).

a new field at Veradero was expected to produce at least as much as Guanabo

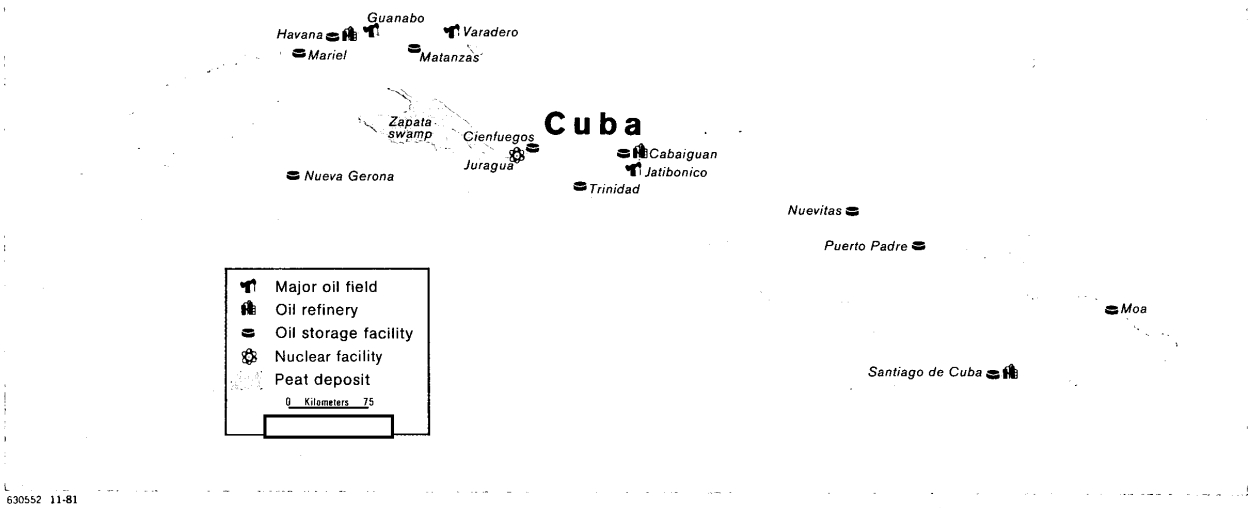
Domestic production in 1981 may thus have been even less than the modest level of 5,800 b/d in 1980.

Until recently, Cuba depended on Soviet and East European technical assistance. In December 1980, however, Mexico and Cuba signed a collaboration protocol calling for trade in processed petroleum products; assistance from Petroleos Mexicanos (PEMEX), the Mexican Government-run petroleum company, in improving Cuba's Nico Lopez refinery in Havana, to be accomplished in the midterm; and long-term Mexican aid in oil exploration. The agreement did not provide for sales of Mexican crude oil to Cuba, but a quadripartite exchange may be arranged with the USSR and one of Mexico's European customers.

Domestic Refining and Storage Facilities

Cuba's three oil refineries are Nico Lopez in Havana, Hermanos Diaz in Santiago de Cuba, and the much smaller Cabaiguan refinery Their estimated production is shown in the tabulation below.

Figure 3



Refinery	Production b/d	Percent of Total
Nico Lopez	97,000	70.3
Hermanos Diaz	37,000	26.8
Cabaiguan	4,000	2.9

These refineries, despite considerable expansion, have not kept pace with the surge of imported petroleum, especially in recent years. Between 1975 and 1980 imports of refined oil products increased by 121 percent, while imports of crude increased by only 13 percent (see figure 2).

Efforts are under way, however, to reduce imports of refined products. Both the Nico Lopez and Hermanos Diaz refineries are being modernized and expanded. Construction of another refinery, in Cienfuegos, has recently begun, and the first phase is scheduled to be completed during the current five-year plan.

Cuba's dependence on oil imports is increased by its limited petroleum storage facilities. Although storage capacity has grown by about 18 percent since 1975, there are still only 11 important storage sites on the island (see figure 6). Even at capacity these tanks hold only about 20 percent of the island's annual petroleum requirements—just over a two-month supply. Moreover, the two largest sites—located at the refineries in Havana and Santiago de Cuba—possess nearly 60 percent of Cuba's total petroleum storage capacity. Most of the remaining storage tanks are located at eight large petroleum depots across the island. Because of this extreme concentration of storage capacity, a major breakdown at either of the two principal sites could seriously affect the economy. The tabulation below specifies the capacities of Cuba's oil-storage sites.

Petroleum Storage Facilities

Site	Capacity (barrels)	Total Capacity (percent)
Total	15,330,626	100.0
Refineries	**9,103,095**	**59.4**
Nico Lopez (Havana)	5,319,642	34.7
Hermanos Diaz (Santiago de Cuba)	3,509,035	22.9
Cabaiguan	274,418	1.8
Depots	**6,227,531**	**40.6**
Nuevitas	1,087,524	7.1
Matanzas	953,887	6.2
Cienfuegos	658,309	4.3
Moa	535,243	3.5
Mariel	514,607	3.4
Trinidad	348,794	2.3
Puerto Padre	296,811	1.9
Nueva Gerona	82,356	0.5
Other small depots	1,750,000	11.4

25X

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25X

25X

25X1

25X

Nonpetroleum Energy Sources

Even over the long term, Cuba has little hope of reducing its need for oil. A full-scale effort to utilize all feasible alternatives would have little impact before the year 2000 (see table 5).

Bagasse. Bagasse, a byproduct of sugarcane milling, is Cuba's only significant alternative source of energy. Bagasse traditionally has been an important source of Cuba's energy needs. In 1980 this substance provided an estimated 18 percent of total energy supplies. Its relative importance, however, has decreased since the late 1950s when it provided nearly one-half of total requirements. The use of bagasse as a fuel is limited almost exclusively to the sugar mills, as its bulk and low caloric content make it difficult and uneconomic to transport.

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Table 5

Long-Term Options for Reducing Oil Consumption

Long-Term Options	Petroleum Savings [a] (Percent)	Constraints
Conversion to gasohol.	2	Would require a minimum of three to five years to implement and a significant capital outlay.
Conversion of thermal electric power plants to accommodate a coal/oil mix.	8 to 10	Same as above.
Completing nuclear facility under construction.	10	Not scheduled to be completed until late 1980s.
Construct another 880-megawatt nuclear facility.	10	Would not be operational before 21st century.

[a] Savings are expressed as a percent of total petroleum consumption in 1980.

25X1

Ethanol. Manufactured from the residual syrup (molasses) obtained during the processing of sugarcane—ethanol, or ethyl alcohol, has been used to produce gasohol (90-percent gasoline and 10-percent ethanol) as a domestic cooking fuel, and as a raw material for the chemical industry. After 1969 its use as an energy source declined sharply as a result of government policies diverting molasses from ethanol production to cattle feed production and to exports. Kerosene was promoted as a replacement for ethanol as a domestic cooking fuel because it was cheaper. Most ethanol produced is now used as a raw material—official Cuban trade data indicates that no ethanol has been exported since 1974.

Cuba has, however, recently shown some renewed interest in the use of ethanol to manufacture gasohol. Havana could save up to 10 to 15 percent of its gasoline consumption by doing this. Production of ethyl alcohol, however, would have to almost double to achieve this rate of savings, assuming all ethanol was used to make gasohol. Should it continue to be used by the chemical industry, production would have to at least triple. This could not be accomplished quickly. No new distilleries have been built since Castro came to power, so existing ones are almost certainly inefficient and probably inadequate for a substantial increase in output. Moreover, a major expansion would have negative financial consequences:

- Unless financed by a third country, expansion would require substantial hard currency investment as opposed to Cuba's existing soft currency arrangement with the Soviet Union for imported gasoline. Payoffs would occur only in the long run, if then.
- If Cuba wanted to maintain its level of hard currency earning from sugar exports and expand ethanol production simultaneously, more sugar would have to be produced.

25X1

Even if production of ethyl alcohol were increased to the level where Cuba would save 15 percent of its gasoline consumption, it would produce a savings of less than 2 percent of total energy requirements.

25X1

25X1

Coal. Cuba possesses no known anthracite or bituminous coal deposits. Some deposits of lignite coal have been discovered, but these are small, in remote parts of the island, and therefore uneconomic to develop. Cuba is thus forced to import all its coal from the USSR. Coal, however, accounted for less than 1 percent of energy consumption in 1980. Rising coal prices caused sugar mills and other major coal users to convert to oil in the 1940s. [redacted]

Currently, coal is used mainly by gas-manufacturing plants and as fuel for steam locomotives. It is unlikely that coal will again become an important source of energy since all thermal power plants are designed to use oil. Conversion from oil to coal is expensive—practically unfeasible for a country with little investment capital. [redacted]

A more likely alternative for Cuba would be conversion to a coal-oil mix in its thermoelectric power plants. Coal can be ground and mixed with oil up to a proportion of 30 percent by weight; this would represent a total petroleum savings of 8 to 10 percent. Oil-fired plants require only minor renovations to accommodate the dense mixture. In addition, preparation facilities would have to be constructed at each site. Table 6 provides the estimated total cost of several possible options. [redacted]

Although Cuba's present energy sources are the most economic for the short run, some combination of oil and coal may be necessary in the long term. A combination of oil and coal would be particularly favorable if the Soviet Union provided economic assistance for the conversion and construction costs. Moscow may favor this approach because it would decrease its subsidized oil exports by 700,000 tons (about 5.1 million barrels), representing an annual savings of about $85 million.[4] For Cuba, long-run costs would be decreased as coal, on the BTU basis, is only about three-fourths the price of subsidized oil. [redacted]

[4] This figure is based on estimated average 1981 world-market price of oil of $34 a barrel, a $16.70 subsidized price, and assuming that Cuba would pay the market price for coal. [redacted]

Table 6

Million US $

Electricity Generation: Fuel Costs for Oil and Coal-Oil Mixes [a]

	Coal	Oil	Total	Conversion Costs
Electricity generation if only oil is used				
Soviet oil [b]	0	366	366	0
World market oil [c]	0	746	746	0
Electricity generation using a coal-oil mix [d]				
Soviet oil and coal [d]	32	282	314	240
Soviet oil and world market coal [f]	64	282	346	240
World market oil and coal	64	574	638	240

[a] Based on estimated 1981 electricity generation of 10.5 billion kilowatt-hours.
[b] Based on estimated subsidized price of $16.70 per barrel ($122.41 per ton).
[c] Based on estimated average OPEC crude price of $34.00 per barrel ($249.22 per ton).
[d] Costs are based on using a 30-percent-by-weight coal concentration.
[e] Assuming a subsidized coal price of $32.50 per ton.
[f] Based on average delivered US price of $65.00 per ton of coal.

[redacted]

This project would become even more favorable if Moscow were willing to provide coal at subsidized prices. There are indications that Moscow's exports of coal to Soviet Bloc countries are priced significantly below US coal prices, although there are no specific data available. Nevertheless, the cost to Moscow would be considerably less than the present arrangement. Assuming the subsidized price was one-half the world price, the savings to the USSR would be reduced from about $85 million to $50 million. [redacted]

Thermal Power. Cuba, with Soviet aid, is reportedly planning to construct a large ocean thermal power plant off the southern coast. This is an advanced process—no completed technology exists yet. The Soviets possess only limited knowledge in the field and are attempting to acquire assistance from the Japanese. Even the Japanese are in the experimental stages, however, indicating that the Cuban project will require a developmental phase of at least five to 10 years. Thus, this technology will have no impact on Cuba's energy picture before the 21st century.

Peat. There are considerable deposits of peat in the Zapata swamp in southern Cuba—estimates range from 300 to 900 million metric tons. Even the low estimate represents a substantial amount, but plans for exploitation apparently have been scrapped for several reasons:

- Drainage of the swamp and transportation of the peat would be costly.
- The peat would have a high moisture content, and therefore would be an inefficient energy source.
- Extraction could irreversibly alter the hydrogeological balance of the area and lead to flooding.

Wood. Some fuelwood and charcoal are produced for use as a home cooking fuel, but this amount has been steadily decreasing since the late 1930s, as kerosene and oil-fired stoves gradually replaced wood-burning models. Although fuelwood and charcoal accounted for about 8 percent of energy supplies in 1938, they now supply only 2 percent. There is almost no potential for increased use.

Hydroelectric. Although hydroelectricity production has increased over time it still accounts for less than one-half of 1 percent of energy consumption because Cuba's hydroelectric resources are limited. Most of the rivers in Cuba are short, narrow, and shallow. These disadvantages are magnified by the seasonal flow of the water, which reaches flood proportions during the rainy season and is meager at other times. There are only two hydropower plants on the island—Guase El Guiro, which even at peak flow is marginal, and Cumanayagua Hanabanilla, which generates about 1 percent of Cuba's electricity.

Solar. Cuba reportedly is exploring potential uses of solar energy. It is unlikely, however, that this form of energy would significantly decrease dependence on petroleum. Solar energy is used primarily for heating purposes, and Cuba's heating requirements are minimal.

Nuclear. A Soviet-sponsored nuclear power project has been in the planning and survey stages in Cuba since 1974, but construction did not begin until this year. The generating facility, to be located at Juragua, on the southern coast of the island, will include two 440-megawatt reactors, and is similar to Soviet projects in Eastern Europe.

In late 1974, Castro announced plans to begin work on one reactor during 1977 or 1978, with completion expected by 1984. This schedule was significantly delayed because the first site selected was situated on a geological fault. Although construction at a new site has not yet begun, worker and technician housing as well as a training facility have been built. The Soviet Union also has surveyed the new site and trained Cuban scientists in nuclear physics. Even if large-scale construction of the facility begins this year, it would not be operational until the late 1980s at the earliest.

Although projects of this size normally take only seven to eight years, additional delays of several years, perhaps into the early 1990s, are likely because of:

- Constraints on Soviet resources because of high-priority Soviet nuclear programs under construction in the USSR and Eastern Europe.
- A substantial testing period because of Soviet wishes to allay foreign concerns over reactor safety.
- The inherent inefficiency of the Cuban economy.

The completion of the nuclear plant will enable Cuba to lessen its dependence on oil imports. At a 60-percent operating capacity, the 880-megawatt facility would produce the equivalent in electricity of about 23,000 b/d of oil—10 percent of Cuba's total 1980 oil imports. This will also improve the island's electrical

generating capacity—if completed by 1990, the facility would provide 20 to 25 percent of Cuba's anticipated total electricity requirements. In addition, the nuclear power plant would reduce—albeit slightly—the impact on Cuba of a possible reduction in Soviet oil supplies during the 1990s. [redacted] 25X

Cuba's dependence on Moscow as an energy source will not decrease significantly, however, because Cuba has no known deposits of uranium. All the necessary uranium will probably be obtained from the USSR, which has vast sources of the mineral. Another possible supplier is Namibia, which also has considerable deposits of uranium. Cuba and its forces in Angola support the guerrilla organization struggling against South Africa's occupation of Namibian territory. [redacted] 25X

Soviet-assisted nuclear power projects represent an attractive alternative to the increasing cost (uranium, on a BTU basis, is considerably cheaper than either oil or coal) and possible decreasing supplies of Soviet oil. Cuba, therefore, probably will seek additional nuclear generating facilities. The Cuban press has reported that nuclear power will account for more than 50 percent of the total installed electrical generating capacity in the 1990s, suggesting that at least one, and probably two or more additional 880-megawatt facilities are planned. There are indications that Cuba plans to build one plant in the province of Holguin, to accommodate increased industrial activity in the area. Neither a schedule for construction nor size of the plant have been determined yet. [redacted] 25X