The Orissa Aluminium Complex

Points toward a Debate

Kannan Srinivasan

Vinod Vyasulu

S Rajagopalan

The financial viability and the foreign exchange earnings of the public sector Orissa aluminium project depend crucially on alumina prices and the interest rate on the Eurocurrency loan. Given that present interest rates are substantially higher than assumed by the Government of India and given that we do not possess any leverage to make the alumina price reflect the cost of money or the cost of production, the project seems viable only on the most optimistic assumptions about alumina prices and money and production costs.

Other issues which need to be considered include the size of the alumina refinery where the global optimality of our French consultant has prevailed over the project's optimum; the very free import of plant and equipment the project demands, which can mean under-utilisation of capacity for domestic plant suppliers; the likelihood of a false picture of competitiveness of alumina export arising from possible subsidy by related public sector investments; the expensive decision on provision of captive thermal sets, given that power is virtually a raw material in the production of aluminium; and, finally, question of pollution from the mining operations and the siting of the refinery.

IT is the limited objective of this paper to raise certain questions toward a public debate about the Rs 1,600 odd crore public investment in utilising the bauxite reserves of Koraput district in Orissa, for executing which a new public sector corporation, the National Aluminium Company (NALCO), has been formed. In the next section we give such details of the project as are readily available. In succeeding sections we comment on various aspects of this project. We hope that others more knowledgeable will contribute facts where they are missing, and corrections where they are needed.

I

NALCO has been set up for the purpose of exploiting the vast deposits of bauxite in Koraput district in Orissa. The project is estimated to cost US $ 1.515 billion at first quarter 1980 prices. It involves the first large loan (at commercial rates of interest) by the Government of India. NALCO has a significant involvement of foreign collaboration, with a French based aluminium transnational Pachiney Ugine Kuhlmann (PUK). The bauxite reserves at Panchpatmali are among the largest in the world, and the project is located in a backward, largely tribal district in Orissa.

It had become clear by 1975 that the Panchpatmali and Pottangi deposits of bauxite in Orissa and the Anantagiri and Chintapalli deposits in Andhra Pradesh were exploitable. It was decided that the Orissa deposits be exploited with the help of a Western transnational, and the Andhra deposits through a Soviet aided project. After negotiations, the PUK was chosen to prepare the feasibility report. In January 1981 the Governments of France and India signed a memorandum of understanding. Thereafter PUK was selected as the consultant.

The project was envisaged as one involving 100 per cent export of alumina, with the offtake being guaranteed by PUK. PUK would arrange consortium finance; they would provide the know-how and set up the plant; and they would market the products. It has now been decided that NALCO will smelt half the alumina produced. The bauxite mine is to be located at Panchpatmali; the alumina factory at Damanjodi; and the smelter and captive thermal unit at Talcher.

The mine at Panchpatmali will produce 2.4 million tonnes per year of bauxite and will costs, US $ 85 million. The alumina refinary at Damanjodi, costing US $ 430 million, will produce 800,000 tonnes per year. The US $ 500 million smelter at Talcher will produce 218,000 tonnes per year of aluminium. The captive thermal power station (also at Talcher in Dhenkanal district) will have an installed capacity of generating 720 MW and will also cost US $ 500 million.

The gap between the domestic demand and the supply of aluminium is estimated to be 273,000 tonnes even after the implementation of the project in 1990. In view of the capital cost of larger smelters and captive thermal plants, it has been decided to smelt in India only half the alumina from the Damanjodi refinery.

PUK's market survey found the prospects for NALCO favourable given a projected shortfall of 5 million tonnes of alumina for smelters around the world. It will therefore produce 375,000 tonnes of alumina for export every year, beginning 1986. The reserves of east coast bauxite have been estimated to be as high as 2.7 billion tonnes. The Panchpatmali deposit which is to be mined first contained 377 million tonnes. At a rate of 2.4 million tonnes a year, it should last for 157 years. The Pattangi deposit should last 38 years at the same rate of extraction.

The project is to be financed with a medium term Eurocurrency loan of US $ 680 million to be repaid in 11 semi-annual instalments commencing five years from the date of loan signing; a French government export credit of US $ 400 million; and Government of India resources of US $ 435 million. Apart from the plant and equipment (against French export credit), caustic soda, petroleum coke, fluoride and cryolite will also have to be imported for at least four years.

II

The two most important decisions with regard to this plant are the export of alumina and the Eurocurrency loan. The NALCO Information Memorandum circulated to the bankers in December 1980 has carried an Eurocurrency loan rate of interest of 10 per

cent and a minimum alumina price of 15 per cent of the aluminium price among its financial assumptions.

The practical decision linked to the broader policy question of alumina export is the size of the bauxite-alumina-aluminium operations; they are so intimately linked, it is difficult to say which came first, the decision to export or the decision on the operation size which makes export necessary. Given the large size of the bauxite-alumina operation — 2.4 million tonnes bauxite to match 800,000 tonnes alumina — and the smaller size of the smelter, 218,000 tonnes of the alumina is inevitably destined for export. It was decided on the basis of PUK's techno-economic survey that there was significant economy of scale in the alumina plant; the direct investment per tonne of alumina in the 400,000 tonnes per annum (tpa) refinery (matching smelter) would be 45 per cent higher than the corresponding investment on the 800,000 tpa plant — and cost of production $ 35 more per tonne than in the smaller refinery. This works out to 1.16 per cent of the price of aluminium. PUK recommended that only half the alumina be converted into aluminium, but the details of overall efficiency are not known. When the question of smelting the entire offtake was examined, it was decided that the high capital investment on the smelter and the captive power plant would not justify the larger capacity, given the scarcity of resources. This has meant that although the 100 per cent export orientation of the project has disappeared, a strong export orientation remains; the technical and economic basis for this has been formulated by the French transnational consultant. The pricing formula and penalty clauses are not public knowledge. Further, of the 1.6 million tonnes of alumina presently planned from the east coast bauxite province, 75 per cent is destined for export in this low value added form.

The aluminium companies exercise effective control over the pricing of bauxite, alumina and aluminium in such a fashion that the principal value added is at the stage of smelting. There are two reasons for this. First, there is no co-ordinated pricing policy by the bauxite producers because there is no co-ordinated action by them. The International Bauxite Association's recommended prices for 1981 for bauxite to be 2 per cent of aluminium ingot price and alumina to be 19 per cent of ingot price though modest, are unenforceable. Major producer countries of bauxite-alumina, such as Australia, frequently sell below the IBA recommended international price. The bauxite-alumina producers are further handicapped by not having the option to smelt their alumina. In the majority of cases they do not even have the option of refining the bauxite — only one non-communist member of the IBA possesses smelting facilities; Australia smelts 10 per cent of its alumina.

By comparison, private firms exert enormous control over the international aluminium industry. It was reported for 1979 that private firms controlled 60.2 per cent of world alumina capacity and 76.2 per cent of aluminium capacity; the six major transnationals (Kaiser, Alcan, Alcoa, Alusuisse, Pechiney, Reynolds) control 58.3 per cent of world bauxite production, 64.7 per cent of world alumina production and 51.7 per cent of world aluminium production (including China and Soviet Union and the eastern bloc). Curiously, in the NALCO Information Memorandum, December 1980, it is noted that "the dominance of these six companies has lent stability to aluminium prices". Since this is a financial viability statement for *alumina* export, one wonders whether it can even be *implied* that the dominance of the six lends stability to alumina prices.

The bauxite producing countries have made sporadic attempts to gain control of more and more downstream operations; this endeavour is encouraged by the transnationals, but only upto a point. The producer countries want effective value added passed on to them. This implies a total integration including refining, smelting and fabrication. The transnationals' interests stop with permitting refining. Refining in the producer country — even its ownership by the producer — is to the advantage of the Six. While the bauxite countries can be responsible for production, the changes in the cost of production (caused especially by the violent fluctuations in caustic soda price) are never reflected in the pricing of alumina or aluminium oxide. It continues to be essentially an internal transfer price. Second, freightage costs are greatly reduced: three tonnes of bauxite make one tonne aluminium oxide. This is also relevant since the transnationals are moving increasingly into freightage as well (e g, Alcoa Steamship Company). Lastly, it is very difficult to put up refineries in the West today because of environmental hazards, especially problems of red mud disposal.

Till the seventies, over 90 per cent of aluminium oxide produced was consumed by smelters within own group of companies; 10 per cent was on long-term contract, from bauxite producers to aluminium companies. By 1978 bauxite producer-owned refineries accounted for 20 per cent of the total, and their share was growing, as were spot sales.

On the other hand, ownership by the producer countries of the high value added segments — smelting and fabrication — runs directly contrary to the interests of the aluminium transnationals.

The Department of Mines subgroup to the Planning Commission Working Group projects that the Indian demand for aluminium will rise over the next decade from 325,000 tonnes per annum in 1981 to 843,000 tonnes per annum in 1989-90; the gap between domestic demand and supply is expected to increase from 125,000 tonnes to 273,000 tonnes (even after implementation of the Orissa project). This difference will have to be met with imports; while in the same year we shall be exporting 1.2 million tonnes alumina — the equivalent of 600,000 tonnes of aluminium.

We shall therefore in effect be financing the import of aluminium (for our increasing requirements in transmission lines, wire rods, rolled products and extrusions) through the foreign exchange earned on our sale of alumina.

There are several problems with this arrangement. There is really no free market in bauxite or alumina. It is a market captive to the transnational producers of aluminium, exempt from the laws of supply and demand. The bauxite producing countries even though termed a cartel have not even the capacity to enforce the most modest price ratio or tax.

Under the Manley Government, Jamaica formed the International Bauxite Association in 1974 at Kingston, started levying a 7.5 per cent tax on bauxite exports, and attempted to raise the alumina price from 14-16 per cent to 16-18 per cent of the price of aluminium. It also attempted further control of downstream processing; a second alumina refinery and the first smelter at South Manchester were planned. (IBA members produce 75 per cent of world bauxite, 40 per cent of world alumina, but only 4 per cent of world aluminium.)

The aluminium transnationals made it impossible for Jamaica to raise

finance or buy technology for the refinery or smelter. Bauxite purchases from Jamaica were further cutback from 15 mn tonnes to 10 mn tonnes even during the years of rising demand (1974-76) in the international aluminium industry. For a country which exports only tourism, bauxite, bananas and coffee the cutback was crippling, and was an important ingredient in the collapse of the Jamaican economy and Michael Manley's election defeat.

India is particularly proud that in both the Russian deal (Andhra bauxite) and the French deal (Orissa) there is not a guaranteed offtake by one country or corporation with all its attendant vulnerabilities (e g, such as the agreement with Iran in the case of Kudremukh) but that the alumina will be sold at 'international market prices'. It is true that a guaranteed offtake commodity agreement can leave a producer country exposed. But, it should be emphasised that in bauxite-alumina, the risks in relying on the free market are far greater. The price leverage of the aluminium transnationals increases with the over-supply of alumina-bauxite on the world market. The fate of those producers resorting to free (untied to smelters) sales of alumina is noteworthy. Most recently, in Guyana, as a political initiative following the nationalisation of its bauxite industry, bauxite and alumina have both gone at distress prices. Bauxite and alumina prices are in fact merely internal transfer prices arranged to suit the interests of the operating company in a given producer country; there is no market price.

The transnational companies take turns in assuming the role of the price leader. The example of one is automatically followed. The inclusion of a preplanned profit margin, a return on existing investment and the financing of further investment is included in aluminium pricing. Any increase in variable costs, labour, energy and taxes is automatically incorporated. The aluminium transnationals can increase or decrease production at will in any producer country. Retaliation to producer countries' attempts to organise is especially effective. The amounts to be exported, the destination of exports, are controlled by the Six. Further, most of the downstream fabrication and production is done by them. Noteworthy is the recently announced decision of Alcan to commit several billion dollars of investment in high technology foundries to the automobile industry for downstream fabrication in specific components.

The transnational aluminium companies have always seen it in their interest not only to own smelting operations but to keep them geographically distinct from bauxite mining and, lately, refining. For instance, Ghana has large reserves of bauxite which are unexploited because Jamaican alumina is smelted in Ghana by VALCO (90 per cent Kaiser, 10 per cent Reynolds). Hydroelectric projects were created in the early 1960s specifically to supply power for the smelting operations; the electricity rates remain unrevised, reputedly 2 mils/kwh, among the lowest industrial user rates in the world. Every attempt by Ghana to exploit its bauxite has been sabotaged; and the country has not the political will to stop smelting till its demands have been satisfied or even simply to raise the electricity rates.

The government policy of exporting intermediates to import finished products is another notion gaining general currency. It breaks down to this; aluminium is bauxite plus energy. India possesses cheap bauxite; the West has cheap energy. Follow comparative advantage, we should "marry cheap bauxite to cheap energy". An elegant notion, but it presumes that all international trade is for the absolute good of all partners. The benefit of such cheap energy is not passed on to the Indian consumer; also, it is generally undisputed that energy costs in the next decade will rise much more sharply in the West than in India.

The Bonneville Power Administration of the Pacific North-West group of power companies has, according to the *Metals Bulletin*, entered into major renegotiations with the aluminium companies. This year, power costs for industrial use are expected to rise by 75 per cent from 6 mils/kwh to 10.5 mils/kwh. Over the next fifteen years, it would be as shown below:

	(mils/kwh)
1982-83	15.3
1984-85	19.2
1985-86	21.4
1990	36.2
1995	54.0

An important factor in Bonneville's revision is the revised cost estimates of its nuclear programme; the fresh estimates for its nuclear plants have changed from US $ 5 billion to US $ 17.5 billion. When electricity is cheaper in the Western world, the benefits of cheap power will not be passed on to the foreign consumer; as it gets more expensive, the higher costs of power will be passed on. The expansion programmes of Kaiser, Alcan, Alcoa, etc, envisage the location of smelters in OPEC and energy cheap countries, as the power costs are expected to rise drastically in their home countries.

The sale of NALCO alumina is currently being negotiated for smelters in Dubai, Bahrain, Algeria, Indonesia and Malaysia. Though the NALCO pricing formula (and penalty clauses, etc) are not public knowledge, the Indian team expects to secure alumina export prices for long term contracts in the region of 12 per cent of the aluminium price. With the glut of bauxite-alumina, it is a smelter (buyer's) market; Venezuela has reportedly (June 1981) been able to force down the price of alumina imports to 11 per cent of the ingot price of aluminium. There has been no indication that these countries with energy and financial resources will behave very differently from the aluminium transnationals. All this makes the IBA recommended price of 19 per cent somewhat unreal; or even the NALCO's 'safety margin price' of 15 per cent.

Another popularly expressed idea today runs on these lines: 'The prejudice against exporting raw materials is just a shibboleth. We can't take certain products upto a high value added stage because of (a) capital expenditure, (b) energy costs. It is better to simply look to the return on the investment.'

There are two problems with this approach. One is the nature of the calculation of "return on investment" (to which we shall turn presently). The other is that blanket rules like 'energy is expensive' are taken as absolutes. The argument has been made that, in fact, in the current world situation the export of alumina is the export of power if properly costed. As the pricing of electricity (in developing countries) subsidises the cost of alumina production, a primary requirement is a rational pricing of alumina based on return on investment in aluminium. With no notion of a true cost for alumina, we are exceedingly vulnerable in the business of exporting to import. It costs more and more alumina to import a unit of aluminium, since we have control neither over bauxite-alumina price nor aluminium price. Extremely complex issues of costing non-renewable resources or loss in value added are involved.

Given such a framework, it might well be possible to make out a strong case for focusing on self-sufficiency and for exploiting bauxite in direct proportion to the domestic requirements, letting the rest simply sit in the ground. Given that there is no way of predicting international prices for aluminium,

surely the satisfaction of domestic demand for our State Electricity Boards, our rolling-stock manufacturers and our household consumers should be first priority. The argument has been made that we are better off in the alumina market because it is safer than the aluminium market, dominated as the latter is by the six transnationals. But this is to accept that we should enter a situation of being exploited because it has lower attendant risks and responsibilities. Since there is no way of predicting international prices for purchase, our first absolute priority should be to satisfy domestic demand. One can even envisage the export of aluminium products; the marginal export of a surplus leads to no such dependence on the world market.

The last argument made for the export of alumina is this: 'We have to finance our foreign exchange bill with some exports'. 'Better alumina than bauxite; better alumina than iron ore'. The most important component of our import bill is petroleum. A powerful case has been made by AKN Reddy of Indian Institute of Science, Bangalore for a strategy for energy self-sufficiency. Use of kerosene for lighting and fuel is clearly not in the national economic interest; nor is burning wood directly for fuel, or the use of fuel oil in captive thermal sets in industry. This implies a shift in planning priorities, including a rational transport policy: the reversing of the trend of switchover to long distance trucking from railways, which presently requires the continued subsidy of diesel, sustaining the present high demand of imported petroleum crude.

III

There are major environmental problems associated with bauxite-alumina operations. The mining of bauxite — as is the case with the NALCO operations — is generally open-cast mining. In the NALCO case, it is said to be entirely mechanised; but the details of the methodology are not available. After trees and shrubs are cleared with bulldozers, overburden is stripped. Stripping ratios can be as high as 15 metres overburden to one metre ore. The overburden is stockpiled. Topsoil has to be stockpiled with great care to prevent it being washed away in rain water. (Blending and mining of the ore is necessary to eliminate variations within the orebody.) The ore is loosened with the use of explosives (e g, ammonium nitrate + fuel oil); the excavation is carried out with shovels and haulers; after stockpiling, it is transported to conveyor belts, overhead ropeways and buckets; in some instances, facilities have to be set up for ore beneficiation, washing and drying, then to the alumina refinery.

The Bayer alumina refining process involves dissolution of the hydrated aluminium oxides in bauxite with hot caustic soda solution, at elevated temperatures and moderately high pressures to produce a slurry consisting of a super-saturated sodium aluminate solution, and a process insoluble solid phase which is made up of compounds originating from bauxite and compounds formed during the process. The slurry is settled, sometimes with the aid of flocculants, and the liquid phase decanted and filtered. Alumina is precipitated from the supersaturated solution by the addition of previously precipitated seeds (crystals).

The major areas of environmental management are:

(a) ore mining and site rehabilitation;
(b) environmental management of alumina plants; and
(c) residue disposal.

The immediate environmental problems of bauxite mining are:

(i) disturbance of the land itself;
(ii) soil erosion;
(iii) mine run-off water;
(iv) dislocation of the water balance;
(v) generation of dust, noise and fumes (principally working environment problems for workers);
(vi) spread of diseases and disturbance of natural economic systems; and
(vii) disturbance caused by the creation of infrastructure.

There are major problems of soil erosion associated with strip mining; wind erosion when the bauxite is dry and rain water erosion. The latter is especially relevant in the case of the Koraput project. The location of the deposits on top of the Panchapatmali plateau should make this extremely difficult. There has to be very early rehabilitation of the mined outpits. Perhaps a wall or a bund may have to be constructed around each block while it is being mined to prevent the overburden being washed down the Panchpatmali plateau into the valleys of the Kakrigumma region. It may well turn out that this (rain water erosion) is the single largest environmental hazard in the bauxite mining operations.

The drainage water is a separate environmental hazard. It is reported that bauxite mining operations in the USA discharge about 57,000 cubic metres of water daily. Contact with pyrites in the overburden gives water in opencast mining a PH of 2-4. Lime neutralisation is required to increase the pH to acceptable levels (region of 7), while precipitating the dissolved solutes.

Since there is no analysis of water use in Koraput district, it may be too early to hazard guesses on the effect of dislocation of aquifers with clearing of vegetation. But it should not be dismissed; it may be discovered that extensive use of well water in the district makes it crucial to restore mined out lands early in order to maintain the level of aquifer recharging. (It has also been noted that there is increased salinity in aquifers in deforested areas. Koraput is such an area.)

Opencast mining can generate 0.25 kg dust per metric tonne of bauxite mined; mines, stockpiles, loading and drying operations. Significant pollution from exhaust fumes during vehicular movement, and noise pollution (primarily affecting workers) can also take place.

Various plant diseases are spread in mining operations. for example, eucalyptus forests (eucalyptus marginala) in South West Australia have been destroyed by the fungus *Phytophthora cinnamon* borne on the wheels of heavy machinery. Teams of ecologists will have to be attached to study the effects of mining operations on wild life.

Red mud disposal is a most crucial parameter in choice of site for the location of the alumina plant. It is because regulations for the environmental safeguards for alumina plants have become so stringent that it is very difficult to gain permission to set up refineries anywhere in the Western world. For the Orissa project too one hopes that red mud disposal has been as important a factor in choice of site as, say, the possibility of an expanded size for the refinery.

Red mud is the waste produced in the separation of alumina from the ore. It is produced as a slurry; depending on the quality of bauxite and the process technology, the red mud alumina ratio can vary from 0.3:1 to 5:1. That is, an 800,000 + tpa plant such as the NALCO project can produce 4 million tonnes per annum of red mud slurry. The following chemicals are noted in the red mud slurry in various forms: Al_2O_3, Fe_2O_3, SiO_2; TiO_2, CaO, Na_2O. Each batch of red mud is unique. It is most important first to dewater the red mud before the disposal into lakes which have to be lined and entirely sealed, preferably with cement or butyl rubber. Under the *anilini* process, it is thickened with rotary drum vacuum filters and fed with a dispersant to reduce viscosity before discharge into

the pond. Unfortunately, in many Third World countries aluminium companies simply dump red mud at random or run it off into ponds, an environmental hazard of incalculable proportions. Since red mud lakes are essentially large caustic reservoirs with pH levels of 11 to 13, there is an extraordinary potential for the contamination of ground water because of the seepage of the red mud liquor into the aquifers. There are several cases where all ground water reservoirs are contaminated in excess of the sodium ion concentration standard for potable water of the World Health Organisation. Once the liquor has seeped to the aquifer, there is no known method to abate the flow. It has been estimated that red mud disposal costs vary from US $0.5 to US $1.5 per tonne of alumina produced; an annual cost of about $400,000 to $1.2 million.

In order to give India the benefit of aluminium, what is the cost to the local economy? It may still be an acceptable price, but one would plead for a rigorous costing.

Then there are environmental problems in other dimensions such as culture. Nirmal Sengupta, in his study of the impact of the Bokaro Steel Plant on the Bauri community ("Destitutes and Development", Concept Delhi, 1978) has documented them excellently. We have not discussed these problems of exploitation which accompany such projects.

We feel the following points merit a more detailed discussion.

(i) India is entering the world market as alumina exporter; but alumina produces have no strength in product pricing. There is a smelter-owners' cartel; but there is no comparable bauxite-alumina producers' organisation. For instance, since we intend to finance our purchases of aluminium with the sale of alumina we should take note of the fact that while international aluminium prices are invariably linked to energy prices by smelter owners, alumina (though its cost of production is highly dependent on the pricing of energy intensive caustic soda) is not linked with the price of energy. Further, we are very dependent on the putting up of smelters by countries "with cheap energy and with financial resources" — the countries of West Asia. How safe is any long-term West Asian commitment?

At the time the NALCO project was approved, it was expected that the following smelters would come up (in the non-communist world) and enter the market for alumina purchases between 1982 and end-1985:

	Capacity (000 tonnes per annum)
Canada	
Grand Baie	59*
Kitimat	134†
United States	200†
Europe	
France	55†
West Germany	72†
Norway	200†
Yugoslavia	80†
Eastern Asia	
Malaysia	90
Philippines	70
Indonesia	NA
South Asia	
Saudi Arabia	200*
Bahrain	NA
Dubai	NA
Latin America	
Brazil	160*
Guiana	100*
Trinidad and Tobago	90*
Miscellaneous	100†
Africa	
Algeria	140*
Australasia	
Australia Kuri-Kuri	45†
Portland	120*
Alcan Queensland	150*
Alumax	236*
Tomago Hunter Valley	229*
New Zealand	200*

* New
† Expansion

It does appear that there is a recession in the world aluminium industry. For instance Alcan has reportedly cancelled its A $930 million smelter at Bundaberg in Queensland; Amax of USA has dropped out of the new South Wales Lochinvar smelter and the Japanese companies approached are unwilling to participate. The Alcoa led consortium is unlikely to set up their Western Australia smelter. Now that the State Government has raised electricity charges, the Portland smelter may not come up; it is quite possible that Pechiney's Tomago smelter may be cancelled. New Zealand's $540 million Aramona smelter deal has collapsed following the withdrawal of Alusisse and CSR. The Nippon Light Metal Company has decided to cut back capacity from 300,000 tpa to 124,000 tpa.

The Chief Marketing Manager of Bharat Aluminium Corporation (BALCO) in a paper presented at the all-India Seminar on Aluminium, 1978, cautioned: "... in the recent past decision to set up several alumina plants by many countries, including our own, have been taken. There is hardly any possibility of a matching smelting capacity being created in the world. To this extent, alumina may be governed by a buyer's market to the possible detriment of the countries setting up alumina plants."

The above was stated at a time when it looked as though all the smelter projects earlier mentioned would appear on schedule. Where it possible then to doubt the co-ordination between smelter projects set up by producer countries, what is the situation today? We need to know whether the situation of producer countries generally has deteriorated, and whether our refinery for export becomes less attractive as a result. To quote again from the above paper: "An additional consideration is that the minimum economic capacity of an uptodate alumina plant is at least two to three times larger than the alumina feed required for a modern minimum economic capacity aluminium smelter... No positive investment decision is taken now-a-days without placing on the market with long term tie up, in advance, at last 60-70 per cent of the alumina to be produced." It does appear that NALCO is somewhat of an exception; how vulnerable is it for this reason? The setting up of refineries unco-ordinated with the planning of smelters may well simply subsidise the alumina procurement price of the aluminium MNCs.

(ii) Much is made of India's successful Eurocurrency loan negotiation. To quote one report: "When P C D Nambiar, Chairman of the State Bank of India signed as US $ 680 million syndicated Euro-currency loan on 27th February 1980 in Paris, the event heralded in a new era for India, namely, acceptance by the international financial community of guarantees given by the Union government for the repayment of jumbo loans raised abroad. The NALCO loan, which is history now, saw India crashing the sacrosanct ½ per cent barrier" *Bussiness World*, August 1981. (One should note that despite SBI's relentless self-advertisement they had very little to do at the loan negotiations, which were carried on entirely by NALCO project authorities). However, other countries and public sector corporations secure this margin fairly regularly. Papua New Guinea came in for the first time into the Eurocurrency market and obtained ½ per cent over LIBOR in July 1981. *The Financial Times* of October 9, 1981, reported that British Airways took a 10-year Euro credit at ½ per cent over LIBOR for the first five years, rising to ⅝ per cent in the next five; unlike NALCO it has neither a front-end nor a commitment fee; though, like NALCO it has an unconditional government guarantee. The Government of Austria's syndicate led by Genossenschaftliche Zentralbank was reported to have borrowed (*Financial Times*, October 9, 1981) with a margin of ¼ per cent over LIBOR for the first three years, ⅜ per cent for the next

three years and ½ per cent for the last two only. There is a six-year grace period before repayment. In any case, to have achieved ½ per cent instead of 1 per cent on the spread is nearly irrelevant given that LIBOR itself varies by more than 15 per cent and has even reached 25 per cent.

It should further be emphasised that the lenders have no direct stake or participation in the project, so their loan should be treated as no reflection of project-worthiness; it is unconditionally guaranteed, notwithstanding any failure by NALCO, by the President of India. While the size of smelter and export of alumina were the result of export oriented policy, the resources constraint imposed on public sector managers and civil servants, and internal bureaucratic compromise, the Eurodollar loan was wholly a deliberate policy choice. One cannot blame the particular project authorities for the unviability of the project under Eurodollar conditions. To go abroad and borrow is a decision taken at the Cabinet and not at the technical level.

The NALCO financial viability assumes a fixed London Interbank Borrowing Rate of 10 per cent. This is a highly unlikely projection. The financial IRR is very sensitive to the rate of interest applied to loan capital. There will be radically different consequences if the Euro loan is taken at 20 per cent instead of 10 per cent the financial assumption for the project. It is particularly dangerous that these misleading LIBOR rates are being circulated as the basis of the financial projections. The Eurocurrency rate for Paradip has apparently been taken at 7¾ per cent (*Financial Times*, October 5, 1981).

The convertible currency option may be rather too fancy for India unless we can really understand European exchange trends very well; we may not really have the market knowledge to become a currency speculator.

(iii) In any project, much depends on the strength of the management team. Till a year after the formation of the National Aluminium Corporation (NALCO) the project had neither a Chairman nor a Managing Director nor a Financial Director nor a Technical Director nor any of the general managers for the four plants which comprise the project. The Indian style of public sector appointments increases the costs and hazards of an Eurocurrency loan.

(iv) Power utilised to smelt aluminium is power saved. The modernisation of our rolling stock is the replacement of our present heavy steel wagons with lighter wagons fabricated with aluminium alloys, which require much less energy in transport.

(v) The nature of the calculations of the appropriate size of plant raises some doubts. The alumina refinery size has been so chosen: "after evaluation of the techno-economics of different sizes of the project the capacity of the alumina plant has been determined at 800,000 tounes per annum. The techno-economic study has revealed that direct investment per tonne of alumina in 400,000 tonnes per annum and 600,000 tonnes per annum capacity plants would be higher by about 45 per cent and 18 per cent when compared to the corresponding investment on 800,000 tonnes per annum capacity plant. It has been estimated that an 800,000 tonnes capacity plant would save about US $ 35 and US $ 14 per tonne of alumina respectively when compared with 400,000 tonnes per annum and 600,000 tonnes per annum capacity plants."

This evaluation has been carried out by our French consultant, PUK. This 'techno-economics' is PUK's global figure for alumina plants, not necessarily the appropriate choice for this refinery as a part of a bauxite mining + captive power plant + caustic soda plant + refinery + smelter complex.

The consequence of this choice has been that we are producing twice the alumina we can smelt. There is a saving of $ 30 per tonne of alumina working out to $ 24 million per annum. It is more than offset if we postulate that our alumina be exported at one of the current international prices (11 per cent of aluminium) instead of the government's assumed price (15 per cent of aluminium). Here the difference of $ 70 per tonne of alumina works out to $ 26.25 million. PUK's global optimality has translated into *a segment optimality instead of a total project optimality* as it relates to the nation's economic choice. (By the same logic one could say that the captive thermal plant for the project should be 1200 MW not 740 MW since the former is the greater economy of scale.) This argument holds good for the rest of the project; an optimum exists only with reference to an objective. Unless one knows what is the objective — return on capital, on investment, technical self-reliance, repayment of loan, minimisation of equipment cost, or foreign exchange cost — one has no way of assessing the quality of the decision.

In general, the point needs to be made that for major projects we are dependent on data sources and analysis fed to us by our foreign consultants. We have no independent basis to discuss technology, finance, markets. For instance, the argument made for our entering the world alumina market is that (i) there is expected to be an increased demand of 5 million tonnes starting 1985; and (ii) countries such as Australia are increasing alumina capacities to cope with this increased demand. There is no analysis of future alumina prices. It is extraordinary that for a Rs 1,600 crore project we hesitate to spend Rs one crore or so on a detailed data base.

Internationally the most crucial requirement determining the siting of a refinery is the provision of facilities for the disposal of red mud. This might well be a far more important prerequisite than the planning of additions to capacity.

The location of the smelter at Talcher makes sense only if it is cheaper to transmit alumina by rail than to transmit power by transmission line.

But were the project being based on the 1,480 MW of hydel power being produced in District Koraput, then both the captive thermal set and the captive railway line would be rendered unnecessary with very sifinificant savings in energy cost and in transportation cost.

The choice of consultancy was made because of the claimed greater energy efficiency of Pechiney in the smelter operation. However, the figure provided, of 13,400 kwh/tonne aluminium (vs 17,000 kwh/tonne aluminium for BALCO) is inadequate for a judgment; it refers to electrical energy consumption alone, not to total energy consumption; decrease in electricity consumption need not reflect an overall decrease in energy consumption. It may refer to electrical energy in the Hall-Heroutt cell alone, not the total energy requirements of the smelter. One wonders because such a great difference in energy efficiency between NALCO and BALCO may be difficult, given the fact that they both employ the same Hall-Heroutt process.

Further, the difference between the energy consumption figures need not be so great: BALCO's energy consumption figures need not be so high. A recent study by Prabhakar Shastri, Indian Institute of Science, estimates that steam use at Korba can be reduced by 25 per cent resulting in saving of 6 per cent of total energy consumption.

(viii) We should cost adequately

each import of plant and equipment. We should be clear on how to cost each order of Indian equipment if it is to meet the deadline — in the absolute sense with collaboration or delay if it is possible to manufacture anything in India — given the alternative is a certain foreign exchange outflow and underutilisation of capacity. Domestic suppliers, BHEL, HEC, etc, with large underultilised capacities, will not be able to compete with the speed of intenational manufacturers, nor has the government given them adequate support to move to such a goal. The logic of loan speed will demand that they be bypassed and orders given to those who can fulfil them on international tender or French export credit.

Given the alumina export at different prices and Euroloan and export credits as well as plant supplies, it should be necessary to calculate not just a foreign exchange component but a *total foreign exchange outgo* for the project.

One can surely be alarmed at a situation in which the government can take for granted the non-performance of public sector equipment suppliers — one department of government assumes another cannot work and the Government sanctions the assumption and plans accordingly.

(ix) It is also important to remember that the existing public sector aluminium plant BALCO has been operating way below capacity — around 29 per cent last year. Yet it is assumed the NALCO will never operate at less than 85 per cent capacity (necessitating a 5 per cent increase in aluminium price if pre-tax profit levels are to be maintained). This may be rather unrealistic given that the underutilisation of capacity is not only caused by a lack of firm power but also by poor maintenance. However, were one to assume this were true, one should point out that if existing Indian smelters operated at 95 per cent capacity, 113,000 more tonnes of aluminium could have been produced — about 52 per cent of NALCO's operation. The questions this raises are: (i) How does an investment in utilising already existing capacity (ie, providing firm power to existing smelters) rate as an alternative/additionality to the NALCO investment? (ii) Will not utilising of existing capacity in addition to 218,000 tpa of aluminium from NALCO make it unnecessary to export alumina to finance our import of aluminium?

(x) There is a variety of investments related to the project which do not figure in project costs.

The coalmine and the coal beneficiation plant, the railway line and the berth at Vizag will presumably be borne by the Department of Coal and the Ministry of Railways and the Ministry of Shipping and Transport, totalling about Rs 200 crore. The return on these investments should adequately reflect an export oriented money earning project. Unless the whole package gets an attractive annual revenue amounting to a return on capital investment, the provision of these infrastructural facilities can constitute a hidden subsidy by the Government of India to NALCO; Indian alumina for export may have a false competitiveness. Further, an export project which is not financially viable — such as, for instance, an entry into the world market with no clear prospects at an attractive price — constitutes a subsidy of the procurement price of the Six. The present 10 per cent subsidy on aluminium oxide exports (were it to continue) and the nine-year corporate tax with holiday for NALCO may well fall into the same category.

(xi) No indigenous technology in aluminium and alumina production has been allowed to develop, although BALCO has had collaboration with a 'socialist' country, Hungary, for many years. The distinction between acquiring technology to run a plant and that of learning how to design and build a plant is crucial. BALCO, in its own way, can operate a smelter and produce aluminium, but as with FPDIL, it does not have the technological capability to replicate (an alumina refinery or aluminium smelter). Bauxite samples are still flown abroad since we do not have adequate testing or laboratory facilities. Even the estimate of our reserves has been made by our foreign consultant, PUK. No serious attempt has been made to build up an indigenous design capability. In the 1960s, a proposal was made by the Union Ministry of Mines with the participation of the private aluminium companies; it fell through because of the unsurprising reluctance of the Indian compaines (which have foreign participation and collaboration) to fund indigenous R and D except insofar as it is a tax shelter. Even now, little is being done in this direction. Were we serious about indigenous design we would have put money into it at the time we decided on the project, before beginning negotiations for a consultancy. A modest proposal (of US $ 300,000) for the establishment of a research institute in Bauxite-alumina-aluminium has been put up to the UNDP. This is for an investment of Rs 1,600 crore. When we remember that Japan spent four times the cost of knowhow in absorbing technology, we can begin to see how remote is the possibility of a genuine transfer of technology.

(xii) Koraput district in Orissa is an area of enormous extraction of local resources, in forest produce and minerals, utilising cheap adivasi workers and the captive Bengali labour force resettled under the Dandakaranya project. It supplies the power, raw materials and labour for the monopoly producer of silicon metal in India, IMFA and for the largest unit of JK Papers, both now due to expansion. Its timber goes to two other mills, at Bhadrachalam and Rajahmundry. It is critical to the sal seed based substitute for cocoa butter in the plans of Unilever. Along with its reserves of manganese, quartz, graphite and iron ore, its bauxite reserves are now to be exploited. Koraput's status as an internal colony and a source of cheap raw materials, is being reconfirmed. The possibility of local benefits seems to be little, given the urgency of the project and costs of delay and escalation. Surely considerations of local environment and economy need to be taken into account for real economic development.

(xiii) The above decision also affects the cost of power. A captive thermal set is a very expensive way of producing power (and it introduces distortions into the economic allocation mechanisms). Surely, the alternative choice to providing captive power to BALCO is the improvement of the Madhya Pradesh State Electricity Board? (Like the non-integration of public sector enterprises with equipment suppliers or the bureaucratic compromise at least partly responsible for this project's export of alumina, the unreliability of the State Electricity Boards which is responsible for the provision of captive power sets for all new steel, fertiliser, cement, aluminium, etc, plants cannot be loosely blamed on the public sector manager and civil servants, but is a symptom of the system.)

If captive power be an absolute requirement, then the cheaper it is, the better, since power is a raw material for smelting.

Orissa is a hydel power surplus state, and Koraput a hydel power surplus district. Hydel projects under

construction (with no end-use earmarked yet in Koraput) are:

	(MW)
Upper Indravati	600
Upper Kolab	240
Lower Kolab (planned)	480
Balimela (expansion)	120
Machkund (expansion)	40
Total additional power	1480

Assuming a 30 per cent power factor, the firm power output would be 450 MW. The entire project, including the smelter, can be located in Koraput. Even downstream units can be easily located in the district. Since the state government cannot be relied upon to deliver the goods, these power projects can be taken over by NALCO or NHPC. The thermal station planned at Talcher can feed its power to the Orissa grid.

(xiv) The mining operations are fully mechanised. In the NALCO mines, 2.4 million tonnes of bauxite are mind by 850 people. One trusts that this mechanisation is technically imperative and this choice does not merely represent the avoidance of the financial burden of non-contract labour. Were semi-mechanisation a technically feasible choice, it might serve better the national need to generate employment.

(xv) Can one envisage a situation in which aluminium oxide export sales, actually diminish Indian demand? If these export sales from NALCO and the Andhra project take place at well below the minimum 15 per cent, then NALCO's financial viability would depend increasingly on domestic aluminium sales. It the BICP should fiddle with Indian prices to ensure NALCO's profitability, the higher Indian prices may well mean a substantially lower offtake by the SEBs, which would mean diminished Indian demand. This may well destroy demand for the second smelter.

This is in addition to the chain reaction of delaying electrification programmes (which delays provision of firm power to, among other consumers, aluminium smelters including BALCO).

Conclusion

(a) Both the foreign exchange earnings and the financial viability of our project depend crucially on world alumina prices. However, there is no free market in alumina; prices are merely internal transfer prices of the aluminium transnationals. There is no certainty of adequate return on investment for the producer country.

(b) Secondly, the Orissa aluminium project depends crucially on the cost of money, the interest rate on the Eurocurrency loan. It has been assumed for this project that the London Interbank Offering Rate is a fixed 10 per cent. However, LIBOR has fluctuated between 9 per cent and 25 per cent; it has been quoted recently at 19 per cent (*Economist*, August 7, 1981). Interest is paid four times annually at the average rate prevailing in the quarter.

(c) Thirdly, an important financial assumption is that while sales revenue will increase by 8 per cent annually (compounded) and cost of production will increase by only 7 per cent. Since caustic soda, presently 25 per cent of the cost of alumina production, is conventionally linked to international petroleum prices, there is no control over the cost of production.

We do not possess any leverage to make the alumina price reflect the cost of money or the cost of production. The project is viable only at the most optimistic interpretation of alumina, money and production prices. The only quality of financial viability the project will possess will be when the administered domestic aluminium price is raised to gain an administered profit for NALCO and the private sector aluminium companies with a disastrous effect on the entire Indian economy including our implementation of energy conservation and rural electrification programmes.

Postscript

Some of the same questions can apply to the other alumina project, not yet finalised: the Andhra Alumina Project. We intend to export 600,000 tonnes of alumina every year from the Andhra project. It is based on a collaboration with the Soviet Union, and there is reportedly very heavy Russian lobbying for the project. Yet the Indian effort is restricted to simply attempting to gain a Russia offtake, since there is no report of a market for the alumina. In the absence of a guaranteed offtake, India is in the difficult position of not being able to find alternative buyers if Russia does not buy from us in any particular year; we shall then be compelled to sell at distress prices. The argument that we are liberated from the compulsion to sell at pre-negotiated offtake prices is meaningless in the absence of a market for our product.

This also reflects the question: What is optimum? We are told — with no reference to questions of total project optimality or market for alumina — that a refinery of 800,000 tpa is 'optimum' in Orissa. We are similarly told that a refinery of 600,000 tpa is 'optimal' in Andhra Pradesh. The 'optimal' technology for Orissa is PUK atmospheric pressure digestion because Orissa has the same quality of bauxite as Guinea; the Soviet-owned medium pressure digestion technology is 'optimal' for the same bauxite just across the state border.

References

[This paper had its origins in a project on "Alternative Development Strategies: Experiments in Koraput", co-ordinated by Vinod Vyasulu and financed by the Indian Council of Social Science Research. It also derived support from a programme on Industrialisation and Social Change at the Indian Institute of Management, Bangalore. The authors are grateful to the ICSSR for its support.

The authors have profited from discussions with Dev Nathan, R K Hazari, J K Lahiri, Subbarayan Prasannay, R K Roy, K Ashok Rao, Narottam Shah, Kamaljeet Singh, S L Shetty and Udipi Srinivasan. The responsibility for errors and opinions is, of course, the authors'.]

(i) Vinod Vyasulu "Alternate Development Strategies for Koraput" paper presented at a Seminar in the Giri Institute of Development Studies, Lucknow, February 1981.

(ii) *The Economic Times*, April 4, 1981.

(iii) Sponsored Supplement by National Aluminium Company, *The Economic Times*, March 29, 1981.

(iv) Studies by Biren Anand and Lalatendu Sahoo, January 1981, IIM Library, Bangalore.

(v) RCS Bell (Indian Civil Service), Koraput District, Gazetteer 1936.

(vi) Government of India Working Group on Non-Ferrous Metals, October 1980.

(vii) *International Bauxite Association Journal*, January-March, 1981.

(viii) *Metals Bulletin and Metals Daily*, various issues.

(ix) Government of India Working Group on Energy Policy 1979, Planning Commission.

(x) A K N Reddy, *Current Science*, January 1981. Also in *New Scientist* and *Bulletin of the Atomic Scientists*.

(xi) Prabhakar Shastri, Indian Institute of Science, "Energy Analysis of Aluminium Extraction India" Bangalore 1979.

(xii) First Draft Secretariat Report on the Environmental Aspects of Alumina production, Paris, December 15, 1980, United Nations Environment Programme, Industry and Environment Office, UNEP/WS/A1-2.

(xiii) Bankers Information Memorandum of the National Aluminium Company Limited.

(xiv) Paper No 56 All-India Seminar on Aluminium, October 20-21, 1978, by V Vaidyanathan, Chief Marketing and Development Manager, BALCO.