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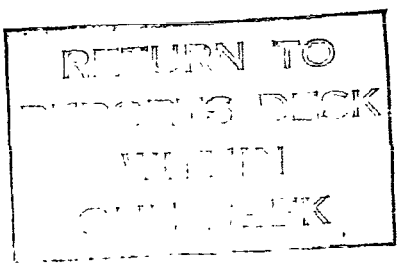

THE ECONOMIC AND SOCIAL DEVELOPMENT OF BRAZIL

(In eight volumes)

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POWER

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CURRENCY EQUIVALENT

Currency Unit: Cruzeiro. (Prior to May 15, 1970, the currency unit was called the "Cruzeiro Novo" or "New Cruzeiro", the adjective was dropped in May 1970, without any change involved.)

Exchange Rates Effective December 15, 1972

Selling Rate:	US$1.00	= Cr$6,215
Buying Rate:	US$1.00	= Cr$6,165

Average Exchange Rates

US$1.00	=	Cr$4.594	Cr$5.285
US$1 million	=	Cr$4,594,000	Cr$5,285,000
Cr$1 million	=	US$217,675	US$189,215

This report is based on the findings of a mission in May, 1972 to Brazil composed of:

Bernard Montfort (Chief of Mission)
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SUMMARY AND CONCLUSIONS

1. Total electricity consumption in Brazil was about 43 billion KWh in 1971, representing a per capita usage of about 440 KWh per annum. Following the economic slowdown of the mid-sixties, national consumption grew at the average annual rate of about 11 percent over the period 1967-71 and is expected to continue growing at almost 12 percent per annum in the seventies. The total installed generating capacity in 1971 was 12,650 MW and is anticipated to increase to about 22,600 MW in 1976.

2. Eighty percent of the country's existing generating capacity is hydroelectric and the balance thermal, reflecting Brazil's natural resource endowment of low-cost hydroelectric potential abundantly available throughout the country and the extreme scarcity of fossil fuels. This is likely to continue in the foreseeable future as the indigenous coal resources are hardly adequate for any significant expansion of thermal capacity, explorations of oil/gas have not yet produced results warranting a change in the energy use pattern, and the country still has attractive undeveloped hydroelectric sites which, in most regions, are adequate to meet the bulk of demand during the rest of the decade and for sometime thereafter.

3. Since the entry of federal and state companies into the power field after World War II, there has been a steady increase in publicly-owned generating plants which today account for 75 percent of the total generating capacity in the country. Private companies which distributed about half of the electric power consumed in the country in 1971, now concentrate on distribution investments, purchasing additional power as needed from publicly-owned companies. Power companies are regulated by the Federal Government through:

(a) the National Department of Water and Electric Energy (DNAEE), a department of the Ministry of Mines and Energy; and

(b) ELETROBRAS, a federal Agency functioning both as a holding Company controlling the operations of federal companies and a general coordinating agency for the sector.

4. The overall investment program for the main companies of the power sector has been generally well conceived within a long-term perspective. During the 1971-75 period, the investment is expected to be about Cr$30,100 million equivalent at mid-1971 prices[1/] or about US$1 billion equivalent each year; about 20 percent will be in foreign currency. The share of distribution in the total investment, 15 percent appears low in view of the fact that distribution since the mid-sixties has been the main bottleneck to the growth of the power market.

1/ US$1.00 = Cr$5.285

5. The mandatory revaluation of assets, the mandatory 10-12 percent rate of return, and the additional charges of reversion and sole tax on power consumption have brought consumer's electricity rates to the point where, without taking into account the compulsory loans contributed by industrial consumers, the sector generates internally about 51 percent of required investment and increase in working capital; including the compulsory loans, the contribution increases to 61 percent.

6. Brazil has succeeded in developing its power sector into a well-managed and financially sound organization which provides an adequate power supply to meet a rapidly growing demand. Some weaknesses remain, however, as explained below.

7. Concessions have been granted for development of hydroelectric sites on common river systems to different companies without prior agreements on water management even though the individual schemes are being implemented according to a well-conceived overall basic plan. Lack of these agreements has begun to create difficulties and the position might deteriorate, as development of new power sites continues and the companies' facilities become hydraulic and electrically interconnected. Both DNAEE and ELETROBRAS are aware of the problem and the need for urgent solutions.

8. The thorough studies carried out by a group of consulting engineers (CANAMBRA) some years ago for the Southeast[1/] and South regions were very helpful in identifying the most economic power generation projects and providing an order of priority for implementation. However, a drift is noticeable in both these regions from the CANAMBRA concept of rational choice of generation schemes and development of a well-integrated power transmission grid. This is due to conflicting aspirations of the Federal and State Governments and also to the limitations of the technical organizations of DNAEE and ELETROBRAS. Progress has not been ideal in evolving a well integrated transmission network necessary for successful implementation of the CANAMBRA program. ELETROBRAS has recently organized, with the help of consultants, comprehensive studies to rationalize the different voltages of the extra-high-voltage systems and development of appropriate interregional links. Further it is trying to set up an effective planning group of system planning experts. Once this is done it should be possible to set up Regional Planning Committees under its aegis with representatives drawn from federal and state companies and functions similar to those assigned earlier to the short-lived Regional Commissions.

9. Committees have been formed for coordinating operations of existing facilities in the Southeast and South regions, and they have been increasingly effective. Important decisions, however, still have to be made by government, outside these committees. These committees would be more effective if DNAEE's present rigid control of rates for inter-system power exchanges is relaxed and companies are given the freedom to depart from authorized tariffs -- mainly related to long-term or regular transactions -- to seek short-term operational economies by direct negotiation and settlement.

1/ Formerly called South Central.

10. As tariffs to final consumers are rigidly calculated according to the stipulated legal rate of return -- which is on a purely financial basis -- the resulting rate pattern is not always economically rational and could lead to economic distortions, for example in the case of industrial developments.

I. THE ENERGY SECTOR

1. In order to put the Brazilian power sector in a global perspective, the whole energy sector is first briefly described and the power sector is thereafter analyzed in more detail in subsequent sections of the report. In Brazil, the Ministry of Mines and Energy (see organization chart appended) is responsible for all matters concerning energy. While the power sector is regulated by the National Department for Water and Electricity (DNAEE), coal comes under the authority of the National Coal Council (CNC), an agency whose functions are to be merged into the National Department for Mineral Production (DNPM). In the oil and gas sector where the National Petroleum Council (CNP) sets Government policy; the Federal Government has a monopoly in oil drilling, transportation and refining, which it carries out through PETROBRAS, a corporation where it is a major shareholder. Nuclear energy is the responsibility of the National Commission for Nuclear Energy (CNEC).

2. In 1970, per capita use of primary energy in Brazil was only 0.47 metric tons of coal equivalent, as compared with 0.71 for Latin America and 1.89 for the world.[1/] Oil products represented the largest share (42 percent) of the primary energy consumption, followed by hydraulic energy (29 percent), while coal accounted for only about 4 percent and the remaining 25 percent was composed of timber, charcoal and sugar cane bagasse.[2/] The general trend is for oil products and hydropower to increase their shares of the total while the contrary is true of firewood, charcoal and sugar bagasse.

Hydro Potential

3. Brazil is endowed with one of the largest hydro potentials in the world, estimated at about 150,000 MW of which only a small fraction (about 7 percent) has been utilized so far, in part because of its remoteness to the consumption areas. More than 50 percent of this total potential is located in the more industrialized South, Southeast and Northeast regions, and has been surveyed in some detail. The remainder, which has been estimated on the basis of topographical characteristics, stream flow and rainfall is mostly located in the Amazon region.

1/ Source: UNO/Statistical Yearbook, 1971.

2/ Source: "Brazil Energy Resources" World Energy Conference, May 1970. For comparison purposes, the Brazilians convert all forms of energy into their oil equivalent following the criteria for conversion utilized in the official statistics of the United Nations, except for the case of hydropower when the oil equivalent is determined on a replacement basis, that is, by computing the quantity of oil needed to produce the same number of kWh in a thermal electric installation of average efficiency.

Coal

4. In Brazil, coal occurs only in the South, the known reserves being of the bituminous and sub-bituminous types and estimated at about 3,200 million tons. Coals of the states of Rio Grande do Sul (2,000 million tons of estimated reserve) and Parana (30 million tons of estimated reserve) are of a very low calorific value, about 3,100-3,200 Kcal/kg and are mostly used in steam power plants. Located in the state of Santa Catarina are deposits estimated at 1,200 million tons, which yield, following washing and separation processes, metallurgical coal suitable for the steel industry. The washery by-product has a low calorific value (4,750 Kcal/kg) and is used in railroads and steam power plants. Data on actual domestic production, imports and consumption of coal over the period 1965-71 may be found in Annex 15. In 1971 about 60 percent of the domestically produced coal originated in the Santa Catarina state and it is expected that the production there will increase further -- eventually doubling by 1980 -- in support of the expansion of the steel industry which otherwise would necessitate increases in coal imports that are judged undesirable by the Federal Government from a balance of payments point of view.

5. The price paid for coal by the electric utilities is as follows:

	Calorific Value (Kcal/kg)	Centavos/Kcal	US¢/10^6 Btu
SOTELCA	4,750	.001430	62.3
CHARQUEADAS	3,100	.001665	72.6
CANDIOTA	3,200	.000434	18.9

Except for CANDIOTA in the state of Rio Grande do Sul where the open pit mining conditions are exceptionally favorable, other seams are thin and require shaft mining; the cost of coal is hence high and contributes to the high level of power costs in the South. The cost of coal at SOTELCA which is regulated by Decree 62113 of January 12, 1968, is 15 percent more expensive (per Btu) than the cost of domestic fuel-oil at the seacoast. Considering further that a coal-fired plant requires somewhat more capital investment than an oil-fired plant, power from SOTELCA is not competitive on commercial grounds and has to be justified by such benefits as employment in the coal mining sector, as well as balance of payments considerations.

Oil

6. The only reserves of oil found so far in a form that can be economically explored is in an area of about 70,000 km^2, representing about 2 percent of the sedimentary area where oil could be expected. At the end of 1968, the recoverable reserves were estimated at 830 million barrels, located on a narrow coastal band that extends from Salvador in the state of Bahia to the state of Alagoas and also in the state of Maranhao. Total domestic production of crude oil in 1970 was 8.1 million metric tons representing about one-third of the country's needs (see Annex 16). Imports of

refined products were also necessary, the total oil refining capacity of the country being at present only about 60,000 tons per day, as detailed in Annex 17. In 1971, total petroleum imports cost Brazil US$245 million (in 1970 prices) or about 8.7 percent of total imports. Imports of crude oil will increase until 1973-74 when wells off the Sergipe coast come into production and increase domestic crude oil output threefold. Total demand for oil products has been growing at about 8 percent average per annum in the late sixties and is expected to continue to grow at 10 percent per annum through the mid-seventies. The use of fuel-oil in steam power plants is by nature subject to random variations from one year to the next as the utilization of those plants is directly dependent on the prevailing hydrological conditions. For example, no fuel-oil imports were necessary in 1969 and 1970 but in 1971, a particularly poor water year, about 400,000 tons had to be imported.

7. Pricing of fuel-oil is regulated by Decree Law No. 61 of November 21, 1966, modified on December 1, 1966. No taxes are levied on fuel-oil and its price is equalized at shipping terminals on the seacoast (130 cruzeiros per ton or about 22$/ton as of December 1971) by means of the National Fund for Freight. Inland freight from those terminals is an additional charge. It is the Government's policy to protect the domestic market for fuel-oil from outside fluctuations in price. For example during the 1968-71 period the domestic price of fuel-oil at shipping terminals on the seacoast experienced variations of a much smaller amplitude (between 18 and 22$/ton) than world market prices which decreased sharply in 1969 and then skyrocketed in late 1970 only to decrease again in late 1971.

8. Other fuels include firewood, charcoal and sugar cane bagasse. Firewood is used only in some small industries and for domestic consumption in rural areas. Charcoal is exclusively used in blast furnaces and small steel mills. Sugar cane bagasse, the waste of crushed sugar cane, is used as fuel to produce steam for the processing of sugar. The above three fuels still contribute about a quarter of Brazil's energy but, remaining stable without any increase, they represent a rapidly decreasing proportion of the total. Other types of energy are of insignificant importance at the moment. Known reserves of natural gas are modest and so was the production of this combustible in 1971, at about one billion cubic meters. Few sites for tidal energy can be found along the Brazilian coast. There are no known sources of geothermal energy. Brazil has large deposits of oil shale but only a small proportion of oil can be obtained from these (a pilot plant for testing the feasibility of economical extraction is presently in operation in the state of Parana). No economically exploitable deposit of uranium has been found so far, but very recent explorations have revealed anomalies in Minas Gerais state's iron ore deposits, which are considered promising. Brazilian resources in thorium are among the largest in the world and may have long-term implications for the development of nuclear power.

II. ORGANIZATION OF THE POWER SECTOR

Historical Background on Organization

9. The power sector of Brazil has evolved into a well-managed and financially sound organization which has succeeded in expanding its activities to adequately meet the demands of the rapidly growing Brazilian economy. The development of Brazil's power sector substantially reflects Brazil's natural endowment of low-cost hydroelectric potential abundantly available throughout the country and occurring alongside extreme scarcity of fossil fuels. Out of the country's total installed generating capacity of 12,650 MW in 1971, about 80 percent was hydroelectric, the balance representing both coal and oil fired thermal and small diesel installations.

10. Until 1934, the industry was owned by foreign private investors and allowed to develop with little government interference. Under the 1934 Constitution, a federal law -- the Water Code of July 1934 -- was enacted, giving the Federal Government jurisdiction over all electric power utilities, and particularly the power to grant rights for the development of hydroelectric sites on all rivers and to regulate power rates. Although amended from time to time, notably in 1957 and 1964, the Water Code is still the basic law governing electricity development in Brazil. The sector is regulated by the Ministry of Mines and Energy, formerly through two divisions, namely the National Council for Water and Electric Energy (CNAEE) and the National Department of Water and Energy (DNAE) which are now one, merged into the National Department for Water and Electricity (DNAEE) in 1969. Federal and state owned public utilities were organized after World War II, to be responsible for generation and main transmission; today they account for 75 percent of the total installed generating capacity. Another important step in the development of power in Brazil was the constitution, in 1961, of a federal agency, Centrais Eletricas Brasileiras, S.A. (ELETROBRAS), to function as a holding company controlling the operations of most federal utilities, to provide financial support to public utilities throughout Brazil, and to act as a coordinating agency for long-term planning studies and general coordination of the country's electrification programs. Administering and allocating public funds amounting to almost half of the total sector investment, ELETROBRAS now has a pivotal role to play in the sector. With federal acquisition of the American and Foreign Power Company properties in 1963, ELETROBRAS became involved in distribution, a function which is progressively being transferred, as a matter of policy to state companies. From the point of view of rational planning of future power developments, by far the most important step taken by the country was the initiation of studies carried out by a consortium of three consulting firms known as CANAMBRA; the studies were financed by UNDP and the World Bank acted as Executing Agency. Two separate studies covering the power market and energy resources of the Southeast and South, completed in 1966 and 1969 respectively, identified and made feasibility studies of potential hydroelectric sites, assessed costs of development in relation to thermal and nuclear alternatives, and laid down the order of priority for implementation

on regional and economic considerations. The Government accepted the findings as a basis for the expansion of power supply in those regions. It further decreed that ELETROBRAS should ensure strict adherence to these development plans, with proper justification for departures. By and large, the concessionaires in the Southeast and South regions have adhered to the CANAMBRA plans.

Present Status of Sector Organization

11. The organizational structure of Brazil's power sector, set out in Decree No. 60824 of June 1967, consists of: (a) two agencies of the Federal Government, viz.DNAEE and ELETROBRAS; (b) federal, state and private concessionaires. Through mergers, power companies, of which there were a large number a decade ago, have tended towards a single utility in each state. The Federal Government is concentrating on bulk supply functions through one large federally-owned bulk supplier in each extensively interconnected region, namely the Northeast, Southeast and South.1/ Although there are still over 700 utilities operating in Brazil, a few large utilities account for most of the activity in the industry. In 1971, the nine largest companies accounted for 90 percent of the utility generation2/ and supplied 76 percent of the demand; the thirty largest companies (details in Annex 1) generated 97 percent of the power and supplied 92 percent of the demand. The only remaining large investor-owned utility now is Light - Servicos de Eletricidade (LIGHT), serving Rio de Janeiro and Sao Paulo, the two largest metropolitan areas of the country. In 1971, private investors other than self-producers -- mainly LIGHT -- generated 23 percent of the total electric energy generated by Brazilian utilities and accounted for 54 percent of total sales, LIGHT accounting for 52 percent of the total. Investor-owned companies now concentrate on distribution investment, purchasing additional power as needed from publicly-owned plants. In 1971, 75 percent of utility generation and 42 percent of sales were controlled by public companies.

National Department of Water and Electric Energy (DNAEE)

12. DNAEE, a department of the Ministry of Mines and Energy (see chart), is the federal agency through which the regulatory responsibilities of the ederal overnment in the electricity supply industry are discharged, excluding nuclear power (see para. 22) and rural electrification (see para. 23). Legally, DNAEE is a powerful body for the implementation of national electrification policies, since DNAEE approves the expansion schemes of all concessionaires3/ and has the responsibility to supervise the operations

1/ For purposes of planning for power the country has been divided into five regions, North, Northeast, West-Central, Southeast and South.

2/ The utility generation represents about 92.5 percent of the national generation.

3/ In accordance with the Water Code of 1934, DNAEE already had the authority of controlling the development of hydroelectric resources through issues of concessions; in 1940 all schemes of conventional thermal generation -- including self-producers projects over 500 KW in capacity -- were brought under federal licensing. Schemes of transmission and distribution are also submitted to and approved by DNAEE.

of the concessionaires primarily through control of tariffs, according to the service-at-cost principle introduced by the Water Code of 1934 and streamlined subsequently for detailed application (see Chapter III on tariffs). DNAEE also has the legal responsibility for collecting, maintaining and publishing all statistical information relating to the electricity supply industry.

13. In fact, DNAEE does not adequately coordinate the activities of the sector in regard to licensing of hydroelectric sites or coordinating development of transmission systems. The example of different concessionaires being allotted hydroelectric sites on the same river -- or on rivers located within an interconnected electric system -- according to an overall master plan but without formal agreement for coordination of water management, is illustrative. This reflects political factors in the relationships between the Federal Government and the states through which the rivers flow. Serious problems have not arisen on this account in the past, but difficulties have now begun to appear and need corrective steps. Although transmission schemes are subject to its approval, DNAEE has not succeeded in ensuring adoption of appropriate common voltages for the extra high voltage systems of contiguous areas. DNAEE evidently does not have the expertise to exercise judgment on matters such as integrated basin and regional planning, detailed long-term planning of power system development, etc. This is also evident from the fact that the functions of ensuring adherence to the CANAMBRA program have been recently assigned to ELETROBRAS, which unlike DNAEE does not have the necessary legal authority behind it. DNAEE has not had an organization of adequate strength and depth fo fulfill such technical responsibilities, partly because its salary levels make it difficult to attract competent staff. In the field of control and supervision of power rates, DNAEE should be better able to fulfill its role of implementing tariff policies which it does in accordance with the law. The very rigidity of the law, however, makes it difficult to obtain a rational system of tariffs (see paras. 33 and 34). There are difficulties also in the maintenance of statistics, which is DNAEE's legitimate concern. Instead, ELETROBRAS prepares its own statistics, a task for which it has no legal authority, relying on the cooperation of its associates.

Centrais Eletricas Brasileiras, S.A. (ELETROBRAS)

14. ELETROBRAS is an autonomous agency under the jurisdiction of the Ministry of Mines and Energy whose main functions are: (i) of a holding company to control the operations of its subsidiaries; (ii) of a financial institution administering and allocating public funds to assist the expansion of federal utilities (it provides some assistance to state and municipal utilities as well[1]); (iii) of a coordinating body, assisting the Ministry of Mines and Energy in general coordination of

1/ ELETROBRAS' charter precludes it from lending to investor-owned utilities.

Brazil's electrification programs and in planning the sector finances (through the production of five-year consolidated sector financial budgets). An organization chart of ELETROBRAS is attached to this report. ELETROBRAS has 13 subsidiaries, all federal concessionaires[1/] in which it has a controlling financial interest. It also has some association with 23 other concessionaires, mostly state-owned, in which it has a minority holding (Annex 18).

15. Without minimizing the importance of its impressive achievements in financing power development, and its initiative in organizing planning studies, ELETROBRAS could play a more effective role in the overall coordination of the power sector's activities. Admittedly, ELETROBRAS does not have legal authority to act in regard to some functions, for example, collecting data from concessionaires (other than its subsidiaries). On the system planning side ELETROBRAS does not have the necessary complement of staff to thoroughly examine all the difficult problems which have arisen. It is here that improvements can be made more easily. ELETROBRAS recognizes this weakness and is taking steps to overcome the deficiency (para. 20).

Concessionaires

16. Brazil has a large number of power concessionaires, over 700, organized as corporations, most of which are municipal institutions of small size. Information on concessionaires is given in: (i) Annex XVIII containing the names of the 63 concessionaires incorporated by ELETROBRAS in its consolidated sector financial projections; (ii) Annex I containing the main characteristics of the thirty largest concessionaires; (iii) Annex XI on regional systems; and (iv) Annexes II and III containing information on number of employees and tariff structure, respectively. The main concessionaires comprise:

(i) the federal bulk supply concessionaires (FURNAS in the Southeast, ELETROSUL in the South and CHESF supplying most of the Northeast);

(ii) the largest state concessionaires are CESP (Sao Paulo) which is in fact almost a bulk supplier, CEMIG (Minas Gerais), CEEE (Rio Grande do Sul), COPEL (Parana), and CELG (Goias); and,

(iii) LIGHT, the private utility covering the Rio de Janeiro and Sao Paulo areas which supplied about half of the utility market in 1971 and also had the largest generation that same year, slightly over that of CESP and FURNAS. LIGHT's future expansion will be based solely on distribution activities with all its additional power requirements being purchased from bulk-suppliers.

1/ ELETROBRAS' subsidiaries comprise all federal concessionaires except those in the territories of Amapa and Brasilia which are owned directly by the Federal Government.

Coordination of Operation of Existing Facilities

17. It is recognized in Brazil that coordination of operation of existing facilities is essential to maximize economic benefits as the new large generating stations come in service, especially in the Southeast and South where generating stations are linked by interconnected networks. A reduction of a few percentage points in the generating capacity in the interconnected areas would mean large savings in capital investment in the seventies. The construction of the very large Itaipu (Sete Quedas) hydroelectric project would reinforce the need for integrated operation. A Coordinating Operating Committee (CCOI), of nine companies of the Southeast region and adjacent areas (FURNAS, CESP, CEMIG, CELF, CELG, CBEE, CPFL, LIGHT and COPEL) was set up by the Ministry of Mines and Energy in 1969. It functions under the overall supervision of DNAEE, and with the technical guidance of ELETROBRAS. A similar coordination committee has been set up in 1971 for the South region.

18. The Southeast CCOI was particularly effective during 1971, an extremely dry water year, in arriving at operational decisions and inter-system power exchanges through which restrictions in supply were averted. Implementation of some of those measures, however, have had to be taken outside the Committee, under government direction. Routine optimization of operations would be difficult to achieve under the circumstances explained. To a large extent, the difficulties are due to the problems of tariffs for inter-system power exchanges. As DNAEE cannot possibly control concessionaires' technical operations in detail, the tariff structure is related to long-term transactions so that it is too rigid to enable practical and mutually cost-saving tariffs to be adapted to the particular set of operating circumstances. A possible solution would be to give the companies the freedom to depart from the tariff structure for inter-system power transfers to seek operational economies by direct negotiation of tariffs suited to the circumstances. This would help decrease the cost of power at bulk supply level where, in 1971, utility exchanges were made at the average rate of 0.064 Cr$/kWh or 1.2 US¢/kWh. However, establishment of properly operating system control centers would much improve the present position.

Coordination of System Planning

19. While the Coordinating Operating Committees provide system coordination on a seasonal and annual basis, they do not have a development planning function and cannot focus on the inter-system improvements needed for better integration of facilities in the long term. The absence of a suitable agency for this purpose is partly responsible for the drift, both in the Southeast and in the South, from the CANAMBRA concept of rational choice of generation sources and development of a well-integrated power transmission system. The Government recognized this problem in 1967 when it decided by Decree No. 60824 of June 1967 to establish five Regional Commissions -- one for each region -- primarily for harmonizing the expansion programs of the respective electric systems within a regional framework based on unified concepts and

criteria, and to continuously update such regional plans. The commissions were to function under the former CNAEE, now DNAEE, with representatives drawn from ELETROBRAS and the constituent states. Only one of these commissions -- for the Southeast region -- was actually constituted and even this was short-lived. The lack of coordination and insufficient attention given to studies of the benefits of integrated operation led recently to an underestimate of the potential available in the Southeast region by nearly 1,000 MW (average) by 1980, or just under 10 percent of the regional total, which, in turn, led to proposals to augment generating capacity through high-cost emergency solutions not in the CANAMBRA program. The entire matter is now under study in the context of preparation of a new development plan for the Southeast region, as agreed with the Bank.

20. More recently, ELETROBRAS has recognized that the presently existing and planned EHV transmission grid does not necessarily represent the best conditions for fully interconnected operations. As of now there are too many high voltages (220, 345, 440 and 500 kV) and insufficient direct inter-system transfer capacities. ELETROBRAS has now set up a committee to study the matter with the help of engineering consultants, including the investigation of the possibility of adopting a common voltage level for the 440 kV and 500 kV systems in the Southeast region. Also, interregional power exchanges between the South and Southeast are being studied by ELETROSUL, under ELETROBRAS' direction. Looking to the future, ELETROBRAS is trying to recruit system planning experts to set up an effective planning group. It should then be possible to set up Regional Planning Committees under the aegis of ELETROBRAS with representatives drawn from federal and state companies. State companies appear to recognize the need for such committees which should have functions similar to those assigned earlier to the Regional Commissions (para. 19) and, in development planning matters, would play a role similar to that of the Coordinating Operating Committees for operational matters.

Training of Personnel in the Power Sector

21. Training programs at various levels are available to power sector personnel[1/], with ELETROBRAS and the Ministry of Mines and Energy acting as coordinators. At higher levels the principal opportunities are: (i) a joint program of the University of Rio de Janeiro (Federal) and the Rensselaer Polytechnic Institute, Troy, New York, started in 1967 for a 15-month electrical engineering course at Master's degree level. (This has resulted in 50 Brazilian engineers graduating in the U.S. up to 1971; 8 more are expected to do so in Brazil in 1972); (ii) a Business Administration course of short duration initiated in 1969 for managers and executives of the power sector. So far 85 have attended the course (68 at the Rensselaer Polytechnic Institute, 17 at the Getulio Vargas Foundation), and it is planned in 1972-74 to train another 160 executives; (iii) a course on systems analysis sponsored by PETROBRAS, the national oil company; and (iv) the training program of the Ministry of Mines and

1/ Annex II shows number of employees of the main concessionaires in 1969.

Energy in energy economics, law, finance, administration, data processing, project analysis, etc., which power sector employees are free to attend. At the operational level, the power concessionaires own 25 training centers for training in operation and maintenance of substations, generating plant, transmission lines, electrical system protection, telecommunications, meter reading, district managing, etc. Funds for financing supervisory training come from ELETROBRAS's own resources and a US$2.5 million USAID loan. At the operational level, the Brazilians, who relied initially on French technical cooperation with training facilities and techniques being furnished by Electricite de France, have now practically taken over the operation of those facilities as well as the planning and financing of new programs.

Nuclear Energy

22. Nuclear energy is under federal control, the prime responsibility for it being that of the Comissao Nacional de Energia Nuclear (CNEN) in the Ministry of Mines and Energy. CNEN has recently jointly agreed with ELETROBRAS to entrust implementation of the first Brazilian scheme of nuclear power generation to FURNAS, a subsidiary of ELETROBRAS, for bulk power generation and transmission in the Southeast.

Rural Electrification

23. The Instituto Nacional de Colonizacao e Reforma Agraria (INCRA) a self-governing agency attached to the Ministry of Agriculture and created in 1970 by the merger of the Instituto Nacional de Desenvolvimento Agrario (INDA) and the Instituto Brasileiro de Reforma Agraria (IBRA) has the responsibility for planning, programming, promotion and control of rural electrification in Brazil. For execution of its programs it enters into agreements with states, municipalities and private utilities. Most of the rural electrification installations are carried out by state concessionaires through specialized departments or subsidiaries, and function through consumer cooperatives. Financing for rural electrification has been available from: (i) budgetary funds from INCRA; (ii) soft loans from the Fundo Federal de Eletrificacao administered by ELETROBRAS; (iii) state contributions; (iv) participation of the cooperatives; and (v) development institutions -- to date, the Inter-American Development Bank has made a loan of US$30.8 million for the purpose.

III. TARIFFS

Historical Background on Tariffs

24. The water code of 1934 established the basic principle that electricity tariffs should be based on actual costs, and would be fixed by the Ministry of Mines and Energy on the basis of applications made by the companies every three years. Decree No. 41019 of February 26, 1957, provided that basic tariffs should produce revenues to cover costs of operation, provisions for amortization or reversion, depreciation, and give a return on investment up to a maximum of 10 percent, calculated on remunerable assets based on their historic costs. Concessionaires could obtain surcharges on the basic tariffs between the tri-annual revisions to cover mandatory wage increases, social benefits, increases in costs of fuel and increases in costs of foreign debt service.

25. When beginning in 1959 inflation began to seriously erode the rate base, application of the Government regulations did not permit rates to rise as rapidly as the general price level, especially for investor-owned concessionaires. As a result concessionaires could not internally generate sufficient cash to meet expansion requirements and the expansion of facilities, especially distribution networks, was virtually arrested by 1963. In 1964, the new Government, aware of the plight of the power industry and the need for immediate corrective action issued a decree which permitted power companies to revalue their assets, in accordance with inflation indices issued annually by the National Economic Council. In 1966 such annual revaluations were made mandatory.

Present Tariff Regulations for Power Concessionaires

26. Effective January 1, 1972, Law 5655 of May 20, 1971, provided that electric power tariffs should be set for each utility and should cover all its operating expenses, including depreciation, a 10-12 percent return on the remunerable investment (defined as the net revalued book value of assets in operation, plus stores inventory plus working capital), and a reversion charge equal to 3 percent of the remunerable investment. The basic tariff is revised yearly and concessionaires are allowed to add to it without DNAEE's authorization, certain surcharges to compensate for direct cost increases: monthly, for mandatory increases in wages, social benefits, fuel cost and cost of purchased power; and semi-annually for increases in foreign debt service caused by changes in the foreign exchange rates (details in Annex III).

27. In addition to the basic tariffs and surcharges referred to above, electricity consumers in Brazil pay taxes and make compulsory loans which provide additional funds to the sector as follows: (i) a Sole Tax (Imposto Unico) on residential and commercial consumers at the rates of 50 percent and 60 percent respectively of a countrywide average electricity charge calculated by DNAEE every three months (fiscal tariff); (ii) a compulsory

loan collected from industrial consumers in exchange for 20-year ELETROBRAS obligations at 6 percent interest net of monetary correction. The loan is up to 35 percent of the fiscal tariff; and (iii) a social security tax of 3 percent of all power bills collected for the benefit of the Ministry of Labor and Welfare (details in Annex III).

Present Level of Tariffs

28. In 1971, the average revenue to the concessionaires from final consumers of electricity, exclusive of reversion, taxes and compulsory loan, was 119 Cr$/MWh or about 2.25 US¢/kWh, which is comparable to what is experienced in advanced industrialized countries, and in Mexico, where it is 2.2 US¢/kWh, but substantially higher than Colombia with 1.3 US¢/kWh. However, when reversion, taxes and compulsory loan are taken into account the consumer actually pays 165 Cr$/MWh or 3.1 cents/kWh. This price is shown broken down in its various components in the table below:

AVERAGE PRICE/TARIFF OF ELECTRICITY IN 1971

	Cr$[1]/MWh	US¢[1]/kWh
Concessionaires' revenue[2], excluding reversion	119	2.25
Reversion	+7	+.14
Concessionaires' revenue, including reversion	126	2.39
Sole tax	+16	+.30
Social security tax	+4	+.07
Price paid by consumer, excluding compulsory loan	146	2.76
Compulsory loan	+19	+.36
Total payment by consumer	165	3.12

1/ Prices of mid-1971 US$1 = Cr$5.285.
2/ From final consumers of electricity.

The high consumer contribution (0.87 cents/kWh) over and above the strict financial cost of service (2.25 cents/kWh) results from the Government policy of having the sector -- that is the concessionaires and the consumers -- to internally generate a large portion of the funds required for financing of expansion, rather than rely to any sizable extent on government budget allocations or capital market resources.

Financial Returns on Power Investments

29. The financial return on the sector's revalued assets is 16-18 percent as follows: 10-12 percent of return on concessionaires' assets, 3 percent of reversion charge and about 3 percent of sole tax. The compulsory loan is not included since it is eventually paid back to the consumers.

30. Regarding new projects, however, each case would have to be assessed separately and the incremental financial return on these projects may depart from the 16-18 percent bracket since the legal requirements are related to returns on concessionaires' total assets, not on incremental projects. A rough cost/benefit calculation on the considered investment program (taking into account the present average tariff plus reversion and sole tax on the benefit side and the investment and operating cost of generation/transmission/distribution with seasonable assumptions made on plant factors, fuel costs, system effects, etc.) shows that the average financial rate of return of this program is of the same order of magnitude as the 16-18 percent return on existing assets. Excepting price increases due to inflation, this is an indication that no substantial increase or decrease in the general level of tariffs is likely in the near future in the context of the present legal framework and given the sector's need for internal cash generation. Again there might be exceptions to this in individual utilities. At any rate, it provides an indication that the average project being presently considered in the investment program is financially attractive.

Regional Average Tariffs and Short-Term Evolution

31. The table shows the average concessionaires' revenues from final consumers in the five regions and the evolution of those over the 1971-75 period as well of total national consumers' payment per MWh:

	1971	1972	1973	1974	1975
	(Cruzeiros of mid-1971 per MWh/US$1=Cr$5.285)				
Revenue of Concessionaires					
Average North Region	194	229	233	234	235
Average Northeast Region	131	139	134	127	124
Average West-Central Region	185	197	201	185	198
Average Southeast Region	117	124	128	130	131
Average South Region	182	200	205	208	213
Average Brazil	126	136	139	140	141
Sole Tax	16	23	23	22	21
Social Security Tax	4	4	4	4	4
Compulsory Loan	19	17	18	19[1/]	19[1/]
Total Consumers Contribution	165	179	183	185[1/]	185[1/]

1/ Subject to renewal of Compulsory Loans.

The concessionaires' revenues varied widely between regions in 1971 and the gap will be widening in the near future. In this respect, the regions can be classified in two groups. The Northeast and Southeast have the cheapest power with power in the Northeast becoming even cheaper than the latter in a few years, in part due to the excellent economic characteristics of the Paulo Afonso hydroelectric complex. The more expensive power is not surprising in the North and West Central, hitherto backward in electricity development, where economies of scale cannot yet be achieved, but requires explanation in the South region which has both coal and water power resources and accounts for 10 percent of the nation's consumption. Primarily this is due to the high content (50 percent) of thermal power generation, and the high rates for coal used by power stations, as fixed by the Government with the overall objective of promoting the local coal industry. Some smaller installations use oil but the cost of imported fuel keeps the cost of production about as high as the coal burning stations. The above table shows that, in the regions and the country as a whole, there is a sudden increase in tariffs of about 8 percent in 1972, mainly due to the change in law allowing a return of 10-12 percent.

Present Structure of Tariffs to Final Consumers

32. Decree Law No. 62.724 of May 17, 1968, establishes uniform rate norms to be followed by the concessionaires while presenting tariff applications, and demonstrating adherence to the three basic principles of covering costs, treats groups of consumers alike and charges consumers differently for different load factors. Setting and revision of tariffs has to be preceded by DNAEE's financial analysis to ensure that all costs are appropriately covered. Under the above decree, consumers have been divided into two main categories -- those connected at or above 2,300 Volts (Group A) and those below it (Group B). Concessionaires have to enter into contracts with consumers of Group A on a two-part tariff -- the demand charge covering the legal return, depreciation and reversion, and the energy charge covering operating expenses, taxes and levies. Group A can be further subdivided for different operating levels, the cost of service being calculated for each voltage level, i.e., tariffs for supply at 220 kV, 132 kV, 66 kV, etc. On the basis of information given to DNAEE, concessionaires can establish tariffs with a decreasing per-unit charge for successive blocks of demand and/or energy consumption of consumers in category A. For supply to consumers in category B the costs are first calculated on the two-part basis, but an equivalent energy tariff is allowed in practice with the introduction of blocks also possible.

33. Annex 4, containing the present tariff structure of 26 representative concessionaires, shows that the geographical pattern of tariffs at a given voltage level is rather erratic. For example, the high-tension tariff of LIGHT is very much lower than that of the other concessionaires in the same interconnected area, such as CESP and CEMIG. From a national viewpoint, it is desirable as far as industrial tariffs are concerned that they signal to the industrial consumers the appropriate economic cost message so that their decisions regarding plant locations/expansions are in the national

interest. From this point of view, the economic cost to supply new loads at say 138 kV should not substantially differ from place to place within a well-interconnected system except for transmission costs. In fact, however, this and other such national objectives can hardly be attained considering the legal tariff framework which provides that tariffs be computed on a purely financial basis for each utility (some of which may have cheaper resources or fully depreciated part of their installations). Also there are cases where the rate base does not reflect the full financial cost, for example by allocation of a portion of the investment cost to non-existent navigation activities. Furthermore, allocating costs between consumer classes is in practice a meticulous task not easily controllable by DNAEE and it appears there is a tendency among some utilities to manipulate tariffs in order to lower high-tension tariffs: some utilities in the South supply a few industrial consumers at almost half the financial costs -- which may well be appropriate in the national point of view -- without specific authorization of DNAEE. DNAEE is concious of the problem and, with the help of ELETROBRAS or concerned utilities, has attempted to find solutions in some cases by using the flexibility the law permits in departing from the strict rule of cost allocation between the various consumer classes.

Inter-System Power Exchanges

34. Recognizing that tariffs for inter-system power exchanges constitute a special condition of supply, DNAEE has been given the authority to take into account the peculiarities of the systems of each concessionaire and establish special tariffs for: (a) interruptible supplies arising from occasional availability of capacity and/or energy; (b) supply outside the periods of peak load; and (c) supply for simple wheeling and/or interchange of energy. For supply of off-peak energy, for instance, the law requires that rates can be decided only after the concessionaire first proves the existence of marketable energy, and then, on the basis of an economic study submitted to DNAEE, accompanied by the respective contracts of supply, which ensure that there is no discrimination between consumers having the same conditions of utilization of service. DNAEE has to approve the contracts under which such supplies are made. But the central issue regarding inter-system power exchanges is that DNAEE's permission is required for every departure from authorized tariffs and this rigid control practically precludes operation of the interconnected facilities on the most economic basis.

IV. THE PRESENT MARKET AND SUPPLY SITUATION

Present Market Situation and Past Trends

35. Total electricity consumption for the whole of Brazil was about 42.9 billion kilowatt hours in 1971 (Annex 5), including self-producers, representing a per capita usage of about 440 kWh per annum. The ratio of about one kilowatt hour consumed by the Brazilian economy for each dollar of Gross Domestic Product is in line with what is experienced in countries with comparable economic structure and development. The consumption grew at the average annual rate of 8 percent during the past decade. However, this period included the sharp economic slowdown of the mid-sixties with a particularly low average growth rate of 3.5 percent annually over the three-year period 1962-65. In contrast, recent trends during the past four-year period 1967-71 show an average annual growth rate of about 11 percent (Annex 6). In 1971, electricity consumption grew 12.4 percent.

36. In 1971, the breakdown of electricity consumption by class of consumers for the market served by the main utilities, representing about 99 percent of the total market, was as follows (Annex 5):

Consumer Class	Consumption (GWh)	% of Total
Residential	9,038	23%
Commercial	5,632	14%
Industrial	18,830	49%
Rural	336	1%
Others	4,888	13%
Total	38,724	100%

In addition, in 1971, privately generated consumption -- mostly for industrial use -- amounted to about 3,600 GWh or 9 percent of the total consumption. Total industrial consumption represented about 53 percent of the national consumption.

37. The above aggregate national statistics hide wide regional disparities, as exemplified in the table below:

Region	Consumption[1] 1971 (GWh)	Approximate Growth Rate 1961-71	Approximate Growth Rate 1967-71	Per Capita Consumption (kWh)	Industrial[2] Consumption (% of Total)
North	460	13.0%	17.5%	117	19%
Northeast	3,860	12.5%	15.5%	140	44%
Southeast	33,500	7.5%	10.3%	795	55%
West Central	750	21.5%	20.0%	147	11.5%
South	4,360	9.1%	12.6%	268	47%
BRAZIL	42,930	8.0%	10.9%	442	53%

1/ Including estimated regional breakdown of small utilities and self-producers.

2/ Regional industrial consumption as a percentage of total regional consumption.

The Southeast region is by far the most developed of Brazil. It contains 43 percent of the population and accounts for 70 percent of industrial and 40 percent of agricultural production. Its power consumption was about 33 billion kilowatt hours in 1971 or about 77 percent of the country's total, with a per capita consumption of 800 kWh, almost twice the national average and approaching that of some developed countries. In fact, most of the nation's industry is located in the Southeast region where the state of Sao Paulo alone accounts for more than half of the nation's industrial consumption. Electricity usage is low in most of the remainder of the country. The Southern region has a per capita consumption of about 270 kWh, mainly because its economy is based on agriculture. The Northeastern region has a per capita consumption of only 140 kWh, with industry responsible for about 44 percent of the regional consumption. The two remaining regions, North and West Central are characterized by a very low, industrial component and per capita consumptions of 117 kWh and 147 kWh, respectively. In the past, growth rates of regional consumptions have been widely differentiated with the electrically less developed regions growing faster than the more developed ones. Over the 1967-71 four-year period for example, the Northern, Northeastern and West Central regions grew, respectively, at 17.5 percent, 15.5 percent and 20.0 percent, therefore tending to represent an increasing -- albeit still very modest -- share of the national market whose growth rate over the same period was 10.9 percent.

Existing Facilities

38. According to DNAEE's statistics, the installed capacity for the whole of Brazil was 11,233 MW in 1970.[1] The table shows the breakdown in 1970 by type of equipment and by region (a list of the main generating plants, with capacity 100 MW or more can be found in Annex 7):

1/ According to ELETROBRAS, it was about 11,450 MW in 1970 and 12,900 MW in

HYDRO AND THERMAL GENERATING CAPACITY, REGIONWISE, 1970[1/]

Region	Hydro/Thermal Breakdown Within Regions			Regional Breakdown of National Capacity		
	Hydro	Thermal	Total	Hydro	Thermal	Total
North	0%	100%	100%	0.0%	7.0%	1.5%
Northeast	81%	19%	100%	9.1%	8.0%	8.8%
Southeast	84%	16%	100%	71.4%[2/]	53.0%	67.6%
West Central	94%	6%	100%	12.3%[2/]	3.1%	10.4%
South	49%	51%	100%	7.2%	28.9%	11.7%
Brazil	79% (8828 MW)	21% (2405 MW)	100% (11233 MW)	100.0% (8828 MW)	100.0% (2405 MW)	100.0% (11233 MW)

1/ Source: DNAEE/ this information not available for 1971 because of lack of regional breakdown of self-producers' facilities.

2/ Includes Jupia hydroelectric plant, the output of which is used in the Southeast.

As can be seen, the Brazilian generating facilities are predominantly hydroelectric, 79 percent in 1971 (73 percent in 1961). This is also true on a regional basis except for the North which is entirely thermal and the South which has hydro and thermal in roughly equal proportion. In the North, the location and size of the two main market areas, the cities of Manaus and Belem have not justified the development of the potential hydroelectric resources so far. In the South, which contains all the coal resources of the country, coal is burnt in steam power plants. Annex 11 contains more detailed information on the supply position in the regions.

Generation, Consumption and Losses

39. In 1961 total generation, net of plant auxiliaries' use[1/] and of LIGHT's internal consumption for pumping water up in its hydroelectric schemes, and consumption amounted respectively to about 23,400 GWh and 19,630 GWh representing 16.1 percent losses attributable to transmission and distribution, and inadequate metering of customers' real consumption due to a shortage of meters. Since then the situation has improved somewhat despite the construction of generating plants far from market areas, due to improvements in the concessionaires' distribution facilities and a more effective metering of consumption; in 1971 losses of about 15.0 percent were experienced (see Annex 6). This is not low by the standards of developed countries and should be expected to decrease further when the distribution systems are further improved but it should be regarded as a substantial achievement.

1/ This item is of limited scope since most of the generating capacity is hydroelectric.

Self-Producers

40. In 1970 there was about 1,200 MW of installed captive generating capacity, mostly all in industrialized regions.1/ This represented 9 percent of the nation's total capacity and was composed about equally of hydro, steam and diesel. The hydro and steam were operated mostly on a permanent basis to supply power to the industry while the diesel operated primarily in emergency. Captive installations expanded at a fast pace in the fifties and early sixties (12.6 percent average per annum over the 1955-63 period), mainly because of severe restrictions in power supply from concessionaires. Since 1963, captive generating capacity has increased very slowly (2.5 percent average per annum over the 1963-70 period) due in part to the economic recession in 1963-67 but also due to the progressively increasing power supply capability of the concessionaires. Regarding the future, it is expected that power supply from captive installations will increase further, albeit at a lower rate than national consumption. A check against over-expansion of captive plants is DNAEE's authority since 1934 of controlling the development of hydroelectric resources through issues of concessions; also in 1940, all schemes of conventional thermal generation -- including self-producers projects over 500 kW in capacity -- were brought under federal licensing. ELETROBRAS' present tentative assumption -- used in this report -- is an average annual growth rate of 7 percent but this is to be confirmed by an ongoing study (see para 45). Minimizing expansion of captive installations is desirable since, except in some special cases, diesel or steam plants in a country endowed with large and economic hydroelectric resources generally represents an increased production cost.

Standardization of Frequency

41. At present about 96 percent of the electricity demand in the country is supplied at the frequency of 60 cycles, the remaining 4 percent, located mostly in the states of Rio de Janeiro and Rio Grande do Sul, having still to be converted from 50 to 60 cycles, under ELETROBRAS' technical supervision. In 1971 conversion was completed in the state of Minas Gerais and almost completed in the state of Guanabara. In the LIGHT's service area of the state of Rio de Janeiro a few large consumers will remain served at 50 cycles until 1973. In this same state a few industrial consumers also remain to be converted in CELF's service area. In the state of Rio Grande do Sul where 115 of the 232 municipalities have already been converted, CEEE, the state concessionaire is working on a program supervised by ELETROBRAS and ELETROSUL for completing the conversion in the state by 1974.

1/ The Southeast, South and Northeast contain about 68 percent, 22 percent, and 14 percent of the total, respectively.

V. LOAD GROWTH

Existing Studies and Aggregate Results

42. Market studies are regularly carried out by concessionaires as a part of their planning studies but global long-term projections in a regional perspective are made only from time to time at a higher level. For example, the Coordinating Committee for Energy Studies in the Amazon (North) created by decree in 1968 has recently completed its market studies for the North through 1985. The study carried out by the CANAMBRA consulting consortium (para. 10) in 1966 for the Southeast included a load forecast for that region up to 1980. This was updated by an ELETROBRAS study in 1969 extending the horizon of the forecast to 1985. A new study of the Southeast was expected to be completed by the end of 1972.

43. The ELETROBRAS market study of 1969 on the Southeast was based on a methodology relying on the basic assumption that the country's economy and its evolution is one of the major determinants of electric power consumption level and growth rates. Industrial loads were surveyed for each major industrial sector in relation with economic parameters for those sectors, the Government providing information concerning future sector economic targets. The projections for residential and commercial loads were made utility wise in relation with consumption per customer, urbanization and saturation rates, repressed demand and self-production, etc. Since 1968, the base year for ELETROBRAS' 1969 forecast, consumption in the Southeast has grown more slowly than expected in 1969 and 1970 but this has been offset by a higher growth in 1971 resulting in a consumption level that year in line with ELETROBRAS' predictions.

44. In addition to the occasional long-term studies mentioned above, ELETROBRAS carries out each year a five-year overall market projection in connection with its five-year consolidated financial projection for the whole sector (see para. 51). The table below was assembled using the market assumption of this 1971-75 study as a starting point and incorporating information regarding the longer term available from the studies mentioned in para. 42 (see also Annexes 9 and 10).

LOAD PROJECTIONS (GWh) AND AVERAGE ANNUAL GROWTH RATES

Year	Main Utilities[1]					Total[2] Brazil
	North	Northeast	Southeast	West Central	South	
1971	390	3,435	30,639	714	3,545	42,929
1975	740	7,749	45,269	1,705	6,017	67,164
1980	1,550	19,280	71,260	4,610	9,600	114,645
Average Annual Growth Over						
1971-75	17.4%	22.6%	10.3%	24.4%	14.1%	11.9%
1975-80	16.0%	20.0%	9.5%	22.0%	9.8%	11.3%

1/ Sixty-six main utilities involved in distribution, covering 98.6 percent of total utilities and over 90 percent of total Brazil.
2/ Including small utilities and self-producers.

Electricity Consumption and Economic Activity

45. Correlations between global electricity consumption and global economic activity of any given country although not always precise enough to base forecasts on solely, are useful as a check on forecasts derived from other methods. In Brazil, however, even a cursory study on these lines -- such as an investigation of the ratio of electricity consumption growth rate to the Gross Domestic Product (GDP) growth rate -- casts some doubt on the assumptions made in this regard under CANAMBRA and ELETROBRAS studies. The latest ELETROBRAS study, for instance, was based on a GDP growth rate of 6.0 percent whereas GDP actually grew at 9.2 percent over the period 1968-71. In the Southeast[1] the demand for electricity grew, as forecast, at about 10.9 percent over the 1968-71 period, so that the actual elasticity coefficient over that period was about 1.15-1.20 whereas ELETROBRAS projections were consistent with an elasticity coefficient of about 1.80-1.85, a result that is rather surprisingly off the mark and leads one to conclude that either the electricity data projections were overly optimistic in relation with the expected 6.0 percent economic growth rate or that the latter economic growth was not consistent with the sector economic parameters and other assumptions incorporated into the study. It is expected that an answer to this question will come from ELETROBRAS' ongoing new market study.

1/ In this case it is acceptable to correlate the electricity consumption of the Southeast alone with the GDP for the whole of Brazil since the growth rate of electricity consumption in the Southeast has been roughly the same as that of the whole of Brazil during the period considered.

46. According to historical data the average elasticity coefficient of national electricity consumption versus GDP observed during the period 1965-71 was about 1.25-1.30, after due corrections are made to allow for the unusually high agricultural output in 1971. This is rather low when considering the modest per capita use of electricity in Brazil and can probably be explained in part by the fact that electricity tariffs are not low and the demand is probably repressed to some extent. As this situation will only improve progressively, it seems reasonable to extrapolate the elasticity of the recent past for the seventies. Using this and a projected GDP growth rate of 8-9 percent envisaged in the main section of this 1972 Economic Report, electricity consumption can be expected to grow at between 10.0-11.7 percent per annum. The upper bound of this bracket is in line with the growth rates for the seventies indicated in the table of para. 44.

VI. EXPANSION PROGRAM UP TO 1985

47. Detailed information regarding the power generation projects under construction, the yearly capacity additions, and the investments on generation, transmission, substations and distribution, is given by region in Annexes XII and XIII for the period 1971-76. The expansion program is substantially firm barring a few thermal station projects whose justification is currently under review by ELETROBRAS. The projects included in this program, are those intended to meet the demands for power up to the end of the present decade, as explained in Annex XI. Detailed information regarding the yearly increases in capacity by company and region, and investments, are, however, not yet available for the period beyond 1976. Regarding the early eighties the position is clear in the Northeast region, but in the South and Southeast regions there is uncertainty about the large 10,000-12,000 MW Itaipu (Sete Quedas) hydroelectric project, located on the international stretch of the Paranaiba River, between Brazil and Paraguay, and expected to be commissioned around 1982 to meet the demand for power during the eighties. The site is currently under active investigation under an agreement between the two countries. A final decision on the implementation of this project is expected to be taken sometime in 1973. In the other regions, plans for the long term await results of the investment surveys now under way (Annex XI).

The 1971-75 Investment Program

48. The expected investments in generation, transmission and distribution over the period 1971-75 compared with the 1966-70 period are given below.

POWER SECTOR INVESTMENTS (EXCLUDING INTEREST DURING CONSTRUCTION)

(In Cr$ million of June 1971 / US$1 = Cr$5.285)

	1966-70		1971-75	
Generation	9,602	(56%)	17,139	(57%)
Transmission and Substations	3,938	(23%)	7,034	(23%)
Distribution	2,668	(15%)	4,370	(15%)
Others	1,095	(6%)	1,560	(5%)
Total	17,303	(100%)	30,103 1/	(100%)

1/ Only 20 percent of this total is in foreign currency.

As can be seen, the breakdown of total investment into the various types of plant is expected to remain stable over this period. The share of transmission (23 percent) is, as expected, larger than in most other systems because of the remoteness of the generating plant from the market areas. The share of distribution (15 percent) appears low in view of the apparent inadequacy of distribution facilities which, in the mid-sixties, was a major bottleneck. It also explains why there is still at present some imbalance between distributing and generating facilities resulting in repressed demand at low voltage levels. The last category of investment, labelled "others", comprises land and building, office equipment, vehicles and miscellaneous. It is decreasing and will represent only 4 percent of total investment in 1975. Regarding evolution of total investment over time, Annex XIII shows that over the period 1966-75 total investment increases at the average annual rate of 11.8 percent broadly in unison with the growth rate of electricity consumption.

The Present Outlook

49. Annex XI deals in detail with the growth of demand, power potential of authorized expansion programs and the likely trends for further expansions required to meet the demand in each of the five regions until 1985. In the Southeast region, the Government of Brazil has agreed at the Bank's suggestion to formulate by the end of 1972 a development plan for the region. In the South region, where the demand is less than projected and new demand surveys are in progress, major changes in the CANAMBRA program have been recently proposed which also require review.

50. By 1980, the large hydroelectric power sites in South and Southeast Brazil will have been almost fully developed. What is left for further development would be small and relatively more expensive. Studies underway on the major international Itaipu (Sete Quedas) project may show that it would provide electricity at favorable prices. If Itaipu (Sete Quedas) is not constructed it would be necessary to provide nuclear/oil-fired large thermal installations, possibly with complementary hydro-peaking installations.

VII. FINANCING SECTOR EXPANSION

1971-75 Financial Projections

51. ELETROBRAS prepares annually a consolidated five-year financial projection, the Orcamento Plurianual do Setor de Energia Eletrica (OPE) from data provided by concessionaires in a yearly survey. The purpose of the survey is to determine the financial requirements of the sector. The 1971 survey comprised 63 power concessionaires (federal, state, municipal and private) responsible for 99 percent of the supply of power by concessionaires (Annex XVIII).

52. The 1971-75 OPE disclosed that the sector would require over that five-year period funds in the amount of Cr$38,800 million (US$7,341 million)1/ of which 87 percent have already been committed, the possible source of 11 percent identified and 2 percent are to be sought. Annex XIX, page 1, presents a yearly forecast Sources and Applications of Funds for the Sector, which is summarized below:

1/ Prices of mid-1971/US$1 = Cr$5.285.

SOURCES AND APPLICATIONS OF FUNDS, 1971-75

(Millions of cruzeiros of mid-1971/US$1 = Cr$5.285)

SOURCES	Committed	Identified	Total	%
Internal Sources				
Power Concessionaires Cash Generation	6,924	-	6,924	17.8
Sole Tax	4,795	-	4,795	12.4
Reversion	4,271	-	4,271	11.0
ELETROBRAS Cash Generation[1/]	4,136	-	4,136	10.6
Reinvestment of Dividends - Federal and State	3,284	-	3,284	8.5
Total Internal Sources	23,410	-	23,410	60.3
External Sources				
Compulsory Loan	2,313	2,169	4,482	11.6
Federal and State Governments' Contributions	2,831	-	2,831	7.3
Other	873	49	922	2.4
Borrowings - Foreign	4,197	2,018	6,215	16.0
Total External Sources	10,214	4,236	14,450	37.3
To be sought			940	2.4
TOTAL SOURCES			38,800	100.0
APPLICATIONS	**Local**	**Foreign**	**Total**	**%**
Investment	23,957	6,146	30,103	77.6
Debt Service	2,905	4,565	7,470	19.2
Increase in Working Capital	1,227	-	1,227	3.2
TOTAL APPLICATIONS	28,089	10,711	38,800	100.0

1/ As detailed in Annex XIX, page 2.

This table illustrates the policy of the Brazilian Federal Government that the sector should generate a substantial portion of its financial needs for expansion. Total internal sources from ELETROBRAS and power concessionaires including federal and state governments' dividends plus sole tax and reversion represent 60.3 percent of the requirements for investment, increase in working capital and debt service. This percentage is raised to the higher figure of 71.9 percent taking into account the compulsory loans from power consumers.

These are average figures over the 1971-75 period which increase to 68.9 percent and 83.1 percent respectively in 1975, as a result of Law 5655 requiring that effective January 1, 1972, the return on remunerable investment should be 10 percent to 12 percent. An alternative way to look at the matter of sector contribution to financing of expansion which is more in line with utility practice is to relate the cash generation net of debt service to the capital requirements. The table below summarizes that situation:

SOURCES AND APPLICATIONS OF FUNDS, 1971-75

(Millions of cruzeiros of mid-1971/US$1 = Cr$5.285)

SOURCES		
Internal Sources		
ELETROBRAS + Power Concessionaires Net Cash Generation 1/	3,590	11.5%
Sole Tax	4,795	15.3%
Reversion	4,271	13.6%
Reinvestment of Dividends - Federal and State	3,284	10.5%
Total Internal Sources	15,940	50.9%
External Sources		
Compulsory Loan	4,482	14.3%
Federal and State Governments' Contributions	2,831	9.0%
Others	922	2.9%
Borrowings - Foreign	6,215	19.9%
Total External Sources	14,450	46.1%
To be sought	940	3.0%
TOTAL SOURCES	31,330	100.0%
APPLICATIONS		
Investments	30,103	96.1%
Increase in Working Capital	1,227	3.9%
TOTAL APPLICATIONS	31,330	100.0%

1/ Gross Cash Generation less Debt Service.

This table shows a 50.9 percent internal contribution (including taxes) towards financing investment and increase in working capital, or 65.2 percent when including the compulsory loan. Again, these are average figures over the 1971-75 period which become 61.4 percent and 79 percent respectively in 1975.

53. The Compulsory Loan (see Annex III, para. 11) provides Cr$2,313 million in 1971-73, and Cr$2,169 million in 1974 and 1975, resulting in a reduction of the financing gap from 8 percent to 2.4 percent of total applications of funds, including debt service.

54. Federal and state budgetary contributions will altogether amount to Cr$2,831 million or 7.3 percent for 1971-75 as follows. Federal contributions, estimated at Cr$368 million for 1971-75 are progressively diminishing (only Cr$20 million in 1975) and are related to programs of regional development. State contributions, estimated at Cr$2,463 million for 1971-75 are primarily capital contributions to state power companies of which Cr$1,650 million is a contribution of the state of Sao Paulo to CESP.

55. Foreign lenders are expected to finance 16.0 percent of the 1971-75 plan. This is based on the assumption that total borrowing in foreign currency will go down from US$299 million in 1971 to an annual amount of US$200 million in 1973, 1974 and 1975. Two-thirds of this financing is already committed as follows (details in Annex XX):

	US$ Million	%
IBRD	287	36.2
IDB	146	18.4
USAID	75	9.4
Kreditanstalt	27	3.4
Eximbank	9	1.1
Commercial Banks	106	13.3
Supplier's Credit	145	18.2
Total	795	100.0

(or Cr$4,197 million)

56. The rest of the plan (Cr$812 million) will be financed mainly by contributions of national development banks and agencies. It has not been the policy of the Federal Government to rely to any large extent on the sale of bonds or stock in the Brazilian market. At the present time there is not a debenture market in Brazil and the stock market is not developed enough to be able to absorb new issues of power concessionaires' stock to any significant extent when compared to financial needs.

57. In the latter part of the present decade, and especially if the decision is made to proceed with the construction of the large Itaipu (Sete Quedas) project, the sector will face a cash squeeze. Demand for power is growing roughly 11 percent per year, and even though over 60 percent of the capital requirements for the sector are internally generated, ELETROBRAS is having difficulties raising the balance, due to declining government contributions, stock market weakness and diminishing assistance from development agencies. It is evident that the sector will have to depend to a growing degree on bilateral financing for equipment, and loans from international agencies. To assist the power sector to maximize foreign currency financing, recent Bank lending has been for civil works and equipment for which bilateral financing was not available, and facilitating joint and parallel bilateral financing; in the proposed loan to LIGHT, Bank participation has been primarily sought on the basis that its presence would enhance LIGHT's ability to sell for the first time bonds in foreign markets.

ELETROBRAS' Role and Leverage in Sector Financing

58. In 1954, Law 2308 was enacted creating the Federal Electrification Fund (Fundo Federal de Eletrificacao) for the financing of installations for the generation, transmission and distribution of electric power. The Federal Electrification Fund, administered by ELETROBRAS, is constituted of: (a) 37 percent of the Sole Tax (Imposto Unico); (b) the budgetary contributions of the Federal Government; (c) certain contributions of autonomous governmental entities; (d) dividends and interest on ELETROBRAS stock and obligations owned by the Federal Government; (e) other minor contributions. In addition, ELETROBRAS channels the compulsory loan and administers the Reversion Fund, for the use of which it pays the Government a 3 percent interest rate after monetary correction. Out of the various funds it administers, ELETROBRAS makes capital available to power companies for expansion in the form of capital contributions, and in the form of short- and long-term loans at an interest rate of 10 percent after monetary corrections. Short-term loans, usually for 120 days, are sparingly used to support power companies faced with temporary cash shortages. Annually, ELETROBRAS studies the financial statements of each power company to decide the ratio of equity long-term loan at which it is going to provide its own financing to the company; the average ratio is 40/60, but companies with heavy construction programs in relation to their revenues might be financed 50/50.

59. ELETROBRAS channels a substantial precentage of the financial resources of the sector, as shown in the table (see Annex XIX, page 3 for details):

1971-75 SECTOR FINANCIAL PROJECTIONS

(% of total requirements including debt service)

Funds Channeled Through:	1971	1972	1973	1974	1975	1971-75
ELETROBRAS	30.5	39.3	46.4	48.2	50.7	43.7
Power Companies	51.5	44.3	36.0	35.3	32.4	39.2
State Governments	15.8	15.6	17.0	16.0	16.5	16.2
Others	2.2	0.8	0.6	0.5	0.4	0.9
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

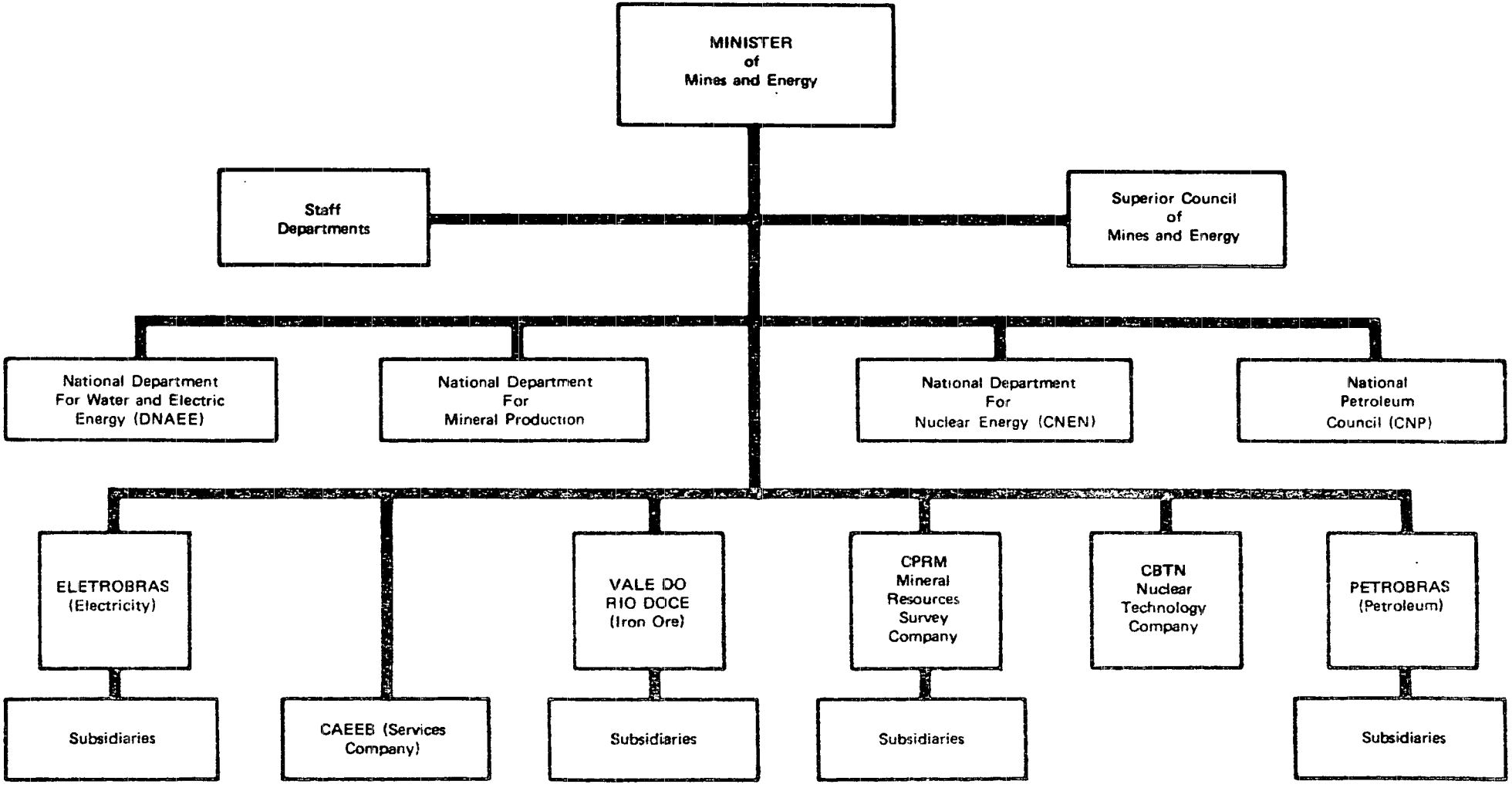
A striking feature of the table is the progressively increasing role of ELETROBRAS -- which is moving toward channeling in the near future about half of the sector financing funds -- and the diminishing role of power concessionaires. This is because (i) reversion funds have been controlled by ELETROBRAS beginning in 1972 and represent an increasing percentage of sector remunerable assets (from 1.6 percent in 1971 up to 2.9 percent in 1975 as shown in Annex 21); and (ii) total borrowing in foreign currency by power concessionaires is forecast to go down from US$299 million in 1971 to US$200 million in 1975.

60. It would appear from the above information that ELETROBRAS, because it channels a large portion of sector funds, should have a very substantial leverage on the Brazilian power sector and therefore should be in a position to ensure rationally integrated operation and planning of the various power concessionaires' systems. While this is true in general, it is limited by the fact that ELETROBRAS is a mere agency of the Government. Further, while ELETROBRAS "channels" a large portion of the sector finances, it in fact "controls" a smaller portion -- 42.9 percent instead of 50.7 percent in 1975 -- as only 40 percent of the Compulsory Loan can be used at ELETROBRAS' discretion. Also, in the absence of legal authority, ELETROBRAS has not been able in the past to overcome pressures from politically strong state-controlled concessionaires. This is unfortunate as these are the very cases where possibilities of substantial economies related to coordinated operation and planning on a regional or national basis present themselves.

BRAZIL

ENERGY SECTOR

ORGANIZATION CHART



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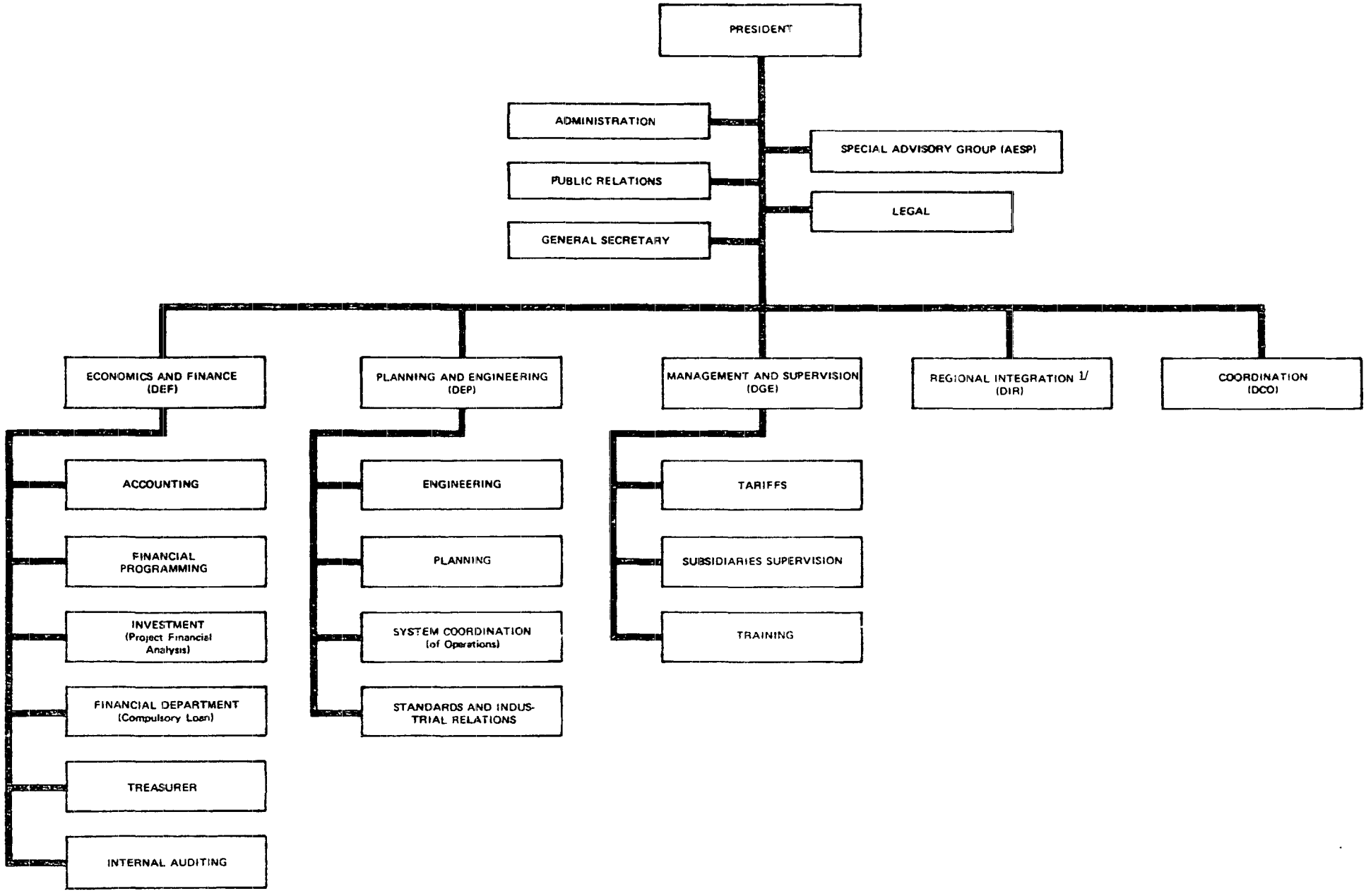
BRAZIL

ELETROBRAS - ORGANIZATION CHART



1/ Relations with other ministries, regional development agencies, and foreign countries

World Bank-6867

MAJOR POWER COMPANIES CHARACTERISTICS

	Company Name	Total Capital 1971 (Million Cr$)	Controlling Interest Owned by: (Fed., State, Private)	Type1/ of Activity	Total Consumers 1971 (1,000's)	Generation Total GWh/ % Hydro	Sales2/ GWh	Principal Client Companies	States (cities) Served
NORTH									
CELPA	Centrais Eletricas do Para	135	Para	GTD	110	321/ -	239	CESP, CELF	Para
CEM	Centrais Eletricas de Manaus	32	ELETROBRAS	GTD	41	184/ -	119	-	Amazon (Manaus)
CEA	Centrais Eletricas do Amapa	100	Federal Government	GTD	n.a.	10/ -	6	-	Amapa
NORTHEAST									
CHESF	Cia. Hidroeletrica de Sao Francisco	700	ELETROBRAS	GTD	5	4,236/100	194	CEEB, CELPE, COELBA, SAELPA	North East Region (Eastern)
CELPE	Cia. de Eletricidade de Pernambuco	113	Pernambuco	TD	335	- -	1,169	CEAL, COELBA, SAELPA	Pernambuco
CEEB	Cia. de Energia Eletrica da Bahia	38	ELETROBRAS	TD	178	- -	713	COELBA	Bahia
COELBA	Cia. de Eletricidade do Estado da Bahia	170	Bahia	GTD	102	109/87	349	CEEB	Bahia
CONEPOR	Cia. Noroeste de Eletrificacao de Fortaleza	28	ELETROBRAS	D	107	- -	272	-	Ceara (Fortaleza)
SAELPA	Sociedade Anonima de Eletrificacao da Paraiba	30	Paraiba	TD	96	- -	162	-	Paraiba
CEAL	Cia. de Eletricidade de Alagoas	20	Alagoas	TD	59	- -	128	-	Alagoas
COSERN	Cia. de Servicos Eletricos do Rio Grande do Norte	22	Rio Grande do Norte	TD	58	- -	124	-	Rio Grande do Norte
COHEBE	Cia. Hidroeletrica de Boa Esperanca	253	ELETROBRAS	GT	-	118/100	-	-	Northeast Region (Western)
SOUTHEAST									
LIGHT	Light-Servicos de Eletricidade, S.A.	2,321	Private	GTD	3,273	10,757/82	19,633	CESP, CELF	Guanabara, Rio and Sao Paulo
CESP	Centrais Eletricas de Sao Paulo, S.A.	5,114	Sao Paulo	GTD	249	9,170/100	1,107	LIGHT, FURNAS, CPFL	Sao Paulo and Mato Grosso
FURNAS	Furnas - Centrais Eletricas, S.A.	905	ELETROBRAS	GT	-	9,097/88	-	CEMIG, LIGHT, CFLP, CBEE	South-Central Region
CEMIG	Centrais Eletricas de Minas Gerais	944	Minas Gerais	GTD	448	3,490/100	4,126	CFLMG	Minas Gerais
CPFL	Companhia Paulista de Forca e Luz	494	ELETROBRAS	GTD	562	2,850/96	2,426	CESP, FURNAS	Sao Paulo
CBEE	Cia. Brasileira de Energia Eletrica	142	ELETROBRAS	GTD	198	260/39	565	CELF	Rio (Niteroi)
ESCELSA	Espirito Santo Centrais Eletricas	54	ELETROBRAS	GTD	86	236/96	405	-	Espirito Santo
CFLMG	Cia. Forca e Luz de Minas Gerais	100	ELETROBRAS	GTD	211	68/100	608	-	Minas Gerais (Belo Horizonte)
CELF	Centrais Eletricas Fluminenses	200	Rio de Janeiro	GTD	129	197/59	349	CESP	Rio de Janeiro
WEST CENTRAL									
CELG	Centrais Eletricas de Goias	330	Goias	GTD	121	989/100	284	CEB, FURNAS	Goias
CEB	Cia. de Eletricidade de Brasilia	132	Federal Government	GTD	76	88/96	283	-	Brasilia
CEMAT	Centrais Eletricas Matogrossenses	138	Mato Grosso	GTD	43	151/46	119	-	Mato Grosso
SOUTH									
CEEE	Cia. Estadual de Energia Eletrica	623	Rio Grande do Sul	GTD	662	1,581/66	1,762	-	Rio Grande do Sul
COPEL	Cia. Paranaense de Energia Eletrica	500	Parana	GTD	159	1,002/93	428	CFLP, LONDRINA	Parana
CELESC	Centrais Eletricas de Santa Catarina	151	Santa Catarina	GTD	220	431/97	627	-	Santa Catarina
ELETROSUL	Centrais Eletricas do Sul do Brasil	488	ELETROBRAS	GT	-	1,045/ -	-	CEEE, CELESC, COPEL	South Region
CFLP	Cia. de Forca e Luz do Parana	92	ELETROBRAS	GTD	145	100/100	252	-	Parana (Curitiba)
LONDRINA	Empresa Eletrica de Londrina	n.a.	Private	GTD	47	84/100	176	-	Parana (Londrina)
	Sub-Total				7,720	46,580	36,627		
	TOTAL FOR BRAZIL					47,780	39,304		
	Self-Producers					3,770	3,625		
	GRAND-TOTAL FOR BRAZIL					51,550	42,929		

1/ G = Generation, T = Transmission, D = Distribution.

2/ To final consumers.

NUMBER OF EMPLOYEES OF MAIN CONCESSIONAIRES (APRIL 1969)

CONCESSIONAIRE[1/]	PERMANENT	TEMPORARY	TOTAL
NORTH			
CERON	64	-	64
ELETROACRE	43	1	44
CELETRAMAZON	200	96	296
CEM	360	-	360
CEA	-	115	115
CELPA	296	-	296
FORLUZ	729	21	750
NORTHEAST			
CEMAR	373	47	420
CEPISA	535	372	907
CELCA	296	14	310
CENORTE	563	98	661
CONEFOR	856	-	856
COSERN	585	507	1,092
COMENSA	65	20	85
CELB	203	3	206
SAELPA	639	-	639
COHEBE	1,012	26	1,038
CELPE	1,867	-	1,867
CEAL	577	-	577
ENERGIPE	280	3	283
COELBA	1,395	-	1,395
CEEB	1,014	-	1,014
WEST CENTRAL			
CEMAT	629	46	675
CELG	1,161	155	1,316
CEB	567	523	1,090
SOUTHEAST			
CEMIG	3,715	55	3,770
CFLMG	1,024	-	1,024
ESCELSA	965	63	1,028
CBEE	1,258	-	1,258
CELF	1,663	101	1,764
LIGHT	23,817	-	23,817
CHESF	4,698	1,703	6,401
FURNAS	2,477	26	2,503
CPFL	3,848	-	3,848
CESP	10,128	47	10,175

1/ Full name of concessionaires may be found in Annex XVIII.

CONCESSIONAIRE	PERMANENT	TEMPORARY	TOTAL
SOUTH			
CFLP	634	74	708
UTELFA	191	1	192
ELETROCAP	407	2	409
COPEL	2,013	94	2,107
CELESC	2,544	493	3,037
SOTELCA 1/	504	4	508
CHARQUEADAS 1/	260	-	260
ALEGRETE 1/	435	-	435
CPE	305	22	327
CEEE	6,898	1,072	7,970
TOTAL	82,093	5,804	87,897

1/ Now part of ELETROSUL.

Source: ELETROBRAS - AESP.

BACKGROUND MATERIAL ON PRESENT TARIFF AND FINANCIAL REGULATIONS

General

1. The level and structure of the basic tariffs a concessionaire charges its customers are regulated by the National Department of Water and Energy (DNAEE) according to provisions contained in the Water Code of 1934 and subsequent amendments (Decree No. 41019 of February 26, 1957; Decree No. 54937 of November 4, 1964; Law No. 5073 of August 18, 1966; Decree Law No. 62724 of May 17, 1968; and Law No. 5655 of May 20, 1971, effective January 1, 1972).

2. By Law 5655 tariff levels should be sufficient to cover (i) all operating, maintenance and administration expenses, (ii) straight-line depreciation up to 5 percent for thermal installations and up to 3 percent for hydro installations; (iii) a reversion charge equal to 3 percent of the remunerable investment; (iv) and a 10 to 12 percent return on the remunerable investment.

3. According to the Water Code of 1934 companies should apply to the DNAEE every three years for a revision on the basic tariff level. In practice this revision occurs annually on account of revaluation of balance sheet accounts as the Government calculates and publishes each year economic correction coefficients showing the variations in the price levels. The coefficients are issued about one month after the end of each year for the use of industry in general as well as power concessionaires who use them to update the values of plant in service and work in progress, depreciation and reversion reserves and certain local currency loans of ELETROBRAS and the National Development Bank. Between annual revisions, companies may add to the basic tariff -- without advance approval of the DNAEE -- certain surcharges to compensate for compulsory cost increases. For compulsory increases in wages, social benefits, fuel cost and cost of purchased power, the surcharge may be added monthly while for increases in foreign debt service caused by changes in the foreign exchange rates, it may be added semi-annually.

4. In addition to the basic tariffs and surcharges referred to above, electricity consumers in Brazil contribute as follows to taxes and compulsory loans which provide additional finances to the industry: (i) a Sole Tax (Imposto Unico) is imposed uniformly on residential and commercial consumers at the rates of 50 percent and 60 percent respectively of a countrywide average electricity charge calculated by DNAEE every three months; (ii) the compulsory loan is collected from industrial consumers who receive 20-year ELETROBRAS obligations at 6 percent interest; and (iii) a social security tax of 3 percent of all power bills is collected for the benefit of the Ministry of Labor.

Remunerable Investment

5. Law 5655 defines remunerable investment for the purpose of calculating reversion and legal remuneration on investment for individual companies as the addition of: (i) the revalued book value of fixed assets in operation; (ii) cash in hand to the extent that it does not exceed the reserve for depreciation; (iii) stores' inventory up to 3 percent of the revalued book value of fixed assets in operation; (iv) the balance of the Amortization Fund and the Compensation for Shortages Funds (see para. 6 below) for the company deposited at the Banco do Brasil; (v) working capital up to a maximum of two months of average billings; minus the following: (a) the reserve for depreciation; (b) the balance of the account for amortization and compensation for shortages; (c) assets for future use; (d) prepayments and advances.

Account for Compensation for Shortages

6. Since basic tariffs are set at the beginning of each year under a number of assumptions, for example on volume of sales, hydrologic conditions, etc., it may happen at the end of the year that there is a shortage or an excess in the concessionaires' net income resulting in the regurn on remunerable investment falling outside the 10-12 percent bracket. If there is an excess -- which has not happened so far -- it is deposited in a Compensation Fund in the Bank of Brazil to be administered by the DNAEE. If there is a shortage it is charged to an Account for Compensation for Shortages the balance of which is added to the operating costs for the next year. However, if the inclusion of all past shortages has too large an impact in the tariff, DNAEE and the concessionaire might agree to postpone recuperation of all or part of the shortages, in which case the agreed amount will remain in the account and will be considered part of the remunerable investment for that year.

Depreciation

7. Depreciation rates are regulated by Portaria 768 of November 11, 1968 which establishes that the average depreciation could never be over 3 percent for all depreciable assets, except for thermal plants, where the limit would be 5 percent. During the tariff negotiations that take place between DNAEE and the individual concessionaires, DNAEE engineers may decide to use a different overall rate of depreciation than that used by the company, always respecting the limits mentioned above.

Reversion

8. The Water Code of 1934 contemplated the possibility of concessions reverting to the Government and established rules by which the concessionaire should be compensated for his assets. Legislation prior to Law 5655 authorized either amortization of up to 5 percent of total fixed assets in operation or reversion of up to 3 percent on the same base. The advantage of charging

amortization was that the utilities could keep the funds derived from such charges, whereas revenues from reversion had to be paid to the Government and could only be borrowed back by the power concessionaires. Law 5655, effective January 1, 1972, discontinued amortization and required that all concessionaires should compute reversion as 3 percent of the remunerable investment and deposit this amount in a special ELETROBRAS account. ELETROBRAS administers the reversion fund on the Government's behalf. It pays the Government interest at a rate of 3 percent for the fund and lends money out of the fund to power concessionaires at 10 percent interest, a rate that applies also to reversion funds retained by concessionaires prior to January 1, 1972. At ELETROBRAS's discretion, it can use up to 5 percent of this fund to indemnify owners of land flooded by reservoirs. At present all reversion funds are channeled to public concessionaires, mostly federal.

Income Tax

9. Starting in 1972, concessionaires'income is taxed at a rate of 6 percent (this rate independent of the concessionaires' return whereas up to 1971 income was taxed at a rate of 17 percent for a return less than 12 percent and 30 percent above). Concessionaires are not permitted to include income tax as an expense in the tariff application.

Imposto Unico (Sole Tax)

10. The Sole Tax is calculated on the basis of the "fiscal tariff" a countrywide average electricity charge fixed every three months by the Department of Water and Power. Law 5655 disposes that residential consumers will be charged 50 percent of the fiscal tariff per each kWh consumed, and commercial consumers 60 percent. Rural consumers, consumers using less than 30 kWh per month, and consumers supplied only by thermal stations are exempt. The funds are collected by the Government and are distributed as follows:

ELETROBRAS	37%
Department of Water and Power	2%
Staff of the Ministry of Mines and Energy	1%
Municipalities	10%
States	50%
	100%

The funds returned to the States are prorated among them as follows:

According to the State's area	20%
According to the State's population	60%
According to the State's electric power generation	2%
According to the State's electric power consumption	15%
According to the State's flooded area (reservoirs)	3%
	100%

Emprestimo Compulsorio (Compulsory Loan)

11. Law 4156 of November 28, 1962, created a Compulsory Loan to help finance ELETROBRAS. Law 5073 of August 18, 1966, reduced it by half and extended it until the end of 1973. The law requires that industrial consumers take a 20-year obligation at 6 percent interest at a rate equal to 35 percent of the fiscal tariff, a countrywide average of electricity charge fixed every three months by the Department of Water and Power, for each KWh purchased. Industrial consumers with load factor of 30 percent or higher, connected at 2,300 volts or over and with a power bill over 3 percent of total sales qualify for reductions according to a formula established by Decree 68419. All non-industrial consumers are exempt. ELETROBRAS invests 50 percent of the Compulsory Loan collected in each state in power utilities in which the state has a majority interest; 10 percent in power works in the state in question; and the rest at ELETROBRAS' discretion.

Social Security Tax

12. All consumers contribute a special Social Security Tax of 3 percent of their power bill for the Ministry of Labor.

TARIFF[1] STRUCTURE OF MAIN CONCESSIONAIRES, AS OF END OF 1971

Company	Consumer Group/ Voltage	Demand Charge (Cr$/kW)	Energy Charge (Cr$/MWh) 1st Bloc	Energy Charge (Cr$/MWh) 2nd Bloc [2]	Average Charge at 60% Load Factor (Cr$/MWh)	Portaria (No. and Date)
SOUTHEAST REGION						
FURNAS	A1/138-220 KV	25.32	17.60	same	75	184-26/11/71
CEMIG	A11/138KV- distrib. conc.	n.a.	n.a.	same	80	194-29/11/71
	A12/138KV- other	n.a.	n.a.	same	60	
	A2/34.5-138KV	n.a.	n.a.	same	95	
	A3/13.2-34.5KV	n.a.	n.a.	same	115	
CESP	A1/230KV	26.74	24.42	same	85	195-29/11/71
	A2/88-132KV	n.a.	n.a.	n.a.	n.a.	
	A3/22-66KV	28.00	28.39	n.a.	92	
	A4/2.3-13.2KV	28.20	29.76	n.a.	94	
	B1/Residential[3]		260.00	n.a.		
LIGHT	A1/230KV	10.90	20.40	n.a.	45	198-30/11/71
	A2/88-132KV	12.90	22.40	n.a.	52	
	A3/20-40KV	14.00	24.50	n.a.	56	
	A4/2.3-13.2KV	19.60	35.90	n.a.	81	
	B1/Residential[3]		221.70	n.a.		
CPFL	A1/345KV	20.60	13.50	n.a.	60	224-10/12/71
	A2/88-132KV	21.30	22.60	n.a.	71	
	A3/33-66KV	24.20	29.30	n.a.	84	
	A4/2.3-13.2KV	28.20	29.76	n.a.	94	
	B1/Residential[3]		260.00	n.a.		

1/ Excluding all taxes and compulsory loan.

2/ For all concessionaires listed in this Annex with a bloc kilowatt-hour energy charge system, the size of the first bloc is 300 kWh/kW.

3/ Service to residential consumers is at voltages of 110-440 volts. Service at this voltage is typically about 10 percent more expensive for non-residential consumers (tariff B2) and about four times cheaper for street lighting (tariff B3).

Company	Consumer Group/ Voltage	Demand Charge (Cr$/kW)	Energy Charge (Cr$/MWh) 1st Bloc	2nd Bloc 2/	Average Charge at 60% Load Factor (Cr$/MWh)	Portaria (No. and Date)
CELF	A1/138KV	21.44	34.94	same	84)	
	A2/66KV	24.55	38.96	same	95)	
	A3/22-34.5KV	28.62	52.70	same	118)	267-22/12/71
	A4/2.3-13.2KV	29.49	69.91	same	137)	
	B1/Residential 3/		249.15	same		
ESCELSA	A1/132KV	24.00	42.00	same	96)	
	A2/66KV	24.50	50.90	same	107)	
	A3/33KV	25.00	57.30	same	114)	259-21/12/71
	A4/2.2-13.2KV	25.50	62.00	same	120)	
	B1/Residential 3/		260.00	same		
CFLMG	A1/66KV	19.00	54.00	same	97)	
	A2/2.3-13.2KV	22.00	62.00	same	112)	205-02/12/71
	B1/Residential 3/		240.00	same		
SOUTH REGION						
ELETROSUL	A1/Jorge Lacerda	13.57	65.66	same	97)	
	A2/66KV Charqueadas	24.59	100.58	same	118)	
	A3/66-132KV	20.14	71.51	same	151)	196-30/11/71
	A4/13.2-22KV	21.67	101.02	same	157)	
COPEL	A1/220KV + distrib. conc.	22.00	45.00	same	95)	
	A2/88-132KV	22.40	54.00	same	105)	
	A3/33-66KV	22.50	75.00	same	126)	188-29/11/71
	A4/2.3-13.2 KV	23.00	77.00	same	130)	
	B1/Residential 3/		287.00	same		

See page 1 for footnotes.

Company	Consumer Group/ Voltage	Demand Charge (Cr$/kW)	Energy Charge (Cr$/MWh) 1st Bloc	2nd Bloc 2/	Average Charge at 60% Load Factor (Cr$/MWh)	Portaria (No. and Date)
CEEE	A1/66KV	7.52	65.20	same	83	206-02/12/71
	A2/25-66KV	9.94	96.60	same	120	
	A3/2.3-13.2KV 3/	16.56	118.40	same	156	
	B1/Residential 3/		280.00			
CELESC	A1/66-138KV	11.30	57.00	same	83	234-14/12/71
	A2/2.3-44KV 3/	15.00	88.00	same	122	
	B1/Residential 3/		271.00	same		
CBEE	A1/66KV	22.30	38.00	same	89	227-10/12/71
	A2/2.3-13.2KV 3/	22.50	66.62	same	118	
	B1/Residential 3/		237.57	same		
NORTHEAST REGION						
CHESF	A11/220KV	15.00	16.00	11.00	48	185-26/11/71 5-05/01/72
	A12/distrib. conc.	18.00	23.00	14.00	61	
	A21/33-66KV	19.00	27.00	20.00	68	
	A22/2.3-13.2KV 3/	22.00	43.00	32.00	90	
	B1/Residential 3/		130.00	same		
CELPE	A1/33-66KV	18.00	28.00	17.00	66	187-26/11/71
	A2/2.3-13.2KV 3/	19.00	48.00	24.00	84	
	B1/Residential 3/		230.00	same		
CONEFOR	A1/33-66KV	18.60	27.00	19.00	67	229-13/12/71
	A2/2.3-13.2KV 3/	19.70	43.00	25.00	82	
	B1/Residential 3/		230.00	same		

See page 1 for footnotes.

Company	Consumer Group/ Voltage	Demand Charge (Cr$/kW)	Energy Charge (Cr$/MWh) 1st Bloc	2nd Bloc 2/	Average Charge at 60% Load Factor (Cr$/MWh)	Portaria (No. and Date)
CEEB	A1/33-69KV	18.50	25.50	14.50	64	213-07/12/71
	A2/2.3-13.2KV	19.50	40.00	27.00	80	
	B1/Residential 3/		210.00	same		
SAELPA	A1/66KV	18.00	28.00	17.00	65	252-21/12/71
	A2/2.3-13.2KV	19.00	48.00	24.00	84	
	B1/Residential 3/		246.21	same		
COELBA	A1/33-132KV	18.50	25.50	14.50	64	251-21/12/71
	A2/2.3-13.2KV	19.50	40.00	27.00	80	
	B1/Residential 3/		295.00	same		
WEST CENTRAL REGION						
CEB	A1/138KV	15.76	38.50	same	74	224-17/12/71
	A2/2.3-13.2KV	24.00	45.00	same	91	
	B1/Residential 3/		238.00	same		
CELG	A1/13.2-220KV	27.12	43.98	same	106	286-29/12/71
	A2/2.3-13.2KV	28.34	57.03	same	122	
	B1/Residential 3/		260.00	same		
NORTH REGION						
CELETRAMAZON	A1/2.3-13.2KV	15.00	100.00	same	134	245-17/12/71
	B1/Residential 3/		320.00	same		
ELETROACRE	A1/2.3-13.2KV	10.00	140.00	same	163	280-27/12/71
	B1/Residential 3/		320.00	same		

See page 1 for footnotes.

Company	Consumer Group/ Voltage	Demand Charge (Cr$/kW)	Energy Charge (cr$/MWh) 1st Bloc	2nd Bloc 2/	Average Charge at 60% Load Factor (Cr$/MWh)	Portaria (No. and Date)
CEA	A1/2.3-13.2KV 3/	10.00	140.00	same	163)	218-10/12/71
	B1/Residential 3/		320.00	same	)	
CELPA	A1/66KV			same	)	
	A2/34.5KV	11.00	125.00	same	150)	232-14/12/71
	A3/2.3-13.2KV 3/	14.00	135.00	same	167)	
	B1/Residential 3/		264.00	same	)	
CEM	A1/34.5KV	11.00	94.00	same	119)	
	A2/2.3-13.2KV 3/	14.00	108.00	same	140)	282-28/12/71
	B1/Residential 3/		240.00	same	)	

See page 1 for footnotes.

ELECTRICITY CONSUMPTION BY CLASS OF CONSUMERS, REGIONWISE OR STATEWISE, 1971

(GWh)

States	Region	Residential	Commercial	Industrial	Rural	Others	Total
All Northern	North	156.2	91.9	69.0	0.0	73.4	390.5
All Northeastern	Northeast	878.8	473.5	1,500.2	29.5	553.5	3,435.5
Sao Paulo	Southeast	3,800.8	2,347.2	10,006.2	212.6	2,131.7	18,498.5
Minas Gerais	Southeast	738.4	326.4	3,541.8	39.5	404.0	5,050.1
Guanabara	Southeast	1,413.8	1,277.4	958.4	0.0	640.5	4,290.1
Rio de Janeiro	Southeast	723.7	280.5	1,091.0	3.4	290.9	2,389.5
Espirito Santo	Southeast	79.4	42.7	241.4	2.1	45.0	410.6
Sub-Total Southeast	Southeast	6,756.1	4,274.1	15,838.9	257.6	3,512.1	30,638.8
All West Central	West Central	250.3	157.4	75.5	2.0	228.9	714.1
All Southern	South	996.1	635.3	1,345.9	47.3	520.5	3,545.1
Sub-Total	Main Utilities 1/	9,037.5	5,632.3	18,829.5	336.5	4,888.2	38,724.0
Other Utilities							580.0
Self Producers							3,624.6
GRAND TOTAL							42,928.6

1/ 66 main distributing utilities surveyed by ELETROBRAS. With a few exceptions, these are roughly the same as the 63 OPE utilities and represent a market about .3 percent larger.

Source: ELETROBRAS.

NATIONAL INSTALLED CAPACITY AND GENERATION[1] (THERMAL, HYDRO), CONSUMPTION[2] AND LOSSES, 1961-71

Year	Installed Capacity (MW)			Generation (GWh)			Consumption[2] (GWh)	Losses % of Generation
	Thermal	Hydro	Total	Thermal	Hydro	Total		
1961	1,396	3,809	5,205	5,459	18,946	24,405	19,630	19.6
1962	1,603	4,126	5,729	6,496	20,662	27,158	21,857	19.5
1963	1,876	4,479	6,355	7,141	20,728	27,869	22,618	18.8
1964	1,946	4,894	6,840	6,997	22,097	29,094	23,521	19.2
1965	2,020	5,391	7,411	4,613	25,515	30,128	24,268	19.4
1966	2,042	5,524	7,566	4,748	27,906	32,654	26,494	18.9
1967	2,255	5,787	8,042	5,049	29,189	34,238	27,988	18.3
1968	2,372	6,183	8,555	7,631	30,550	38,181	31,399	17.8
1969	2,405	7,857	10,262	8,956	32,692	41,648	34,201	17.9
1970	2,405	8,828	11,233	5,597	39,863	45,460	37,673	17.1
1971[3]	2,450	10,200	12,650			51,000	42,400	16.9
Average Growth								
1961-71	5.8%	10.3%	9.3%			7.6%	8.1%	
1967-71	2.1%	15.2%	12.2%			10.3%	10.9%	

1/ Excludes plant auxiliaries use but includes net generation of self-producers.
2/ Excludes utilities' internal consumption, particularly LIGHT's consumption for water pumping.
3/ Estimated.

Source: DNAEE.

MAIN GENERATING PLANTS (WITH CAPACITY 100 MW OR MORE)

(As of December 31, 1971)

	Name of Plant	Type	Installed Capacity (MW)	Utility	State
1.	Jupia	Hydro	1,200	CESP	Mato Grosso
2.	Furnas	Hydro	900	FURNAS	Minas Gerais
3.	Paulo Afonso	Hydro	821	CHESF	Bahia
4.	Estreito	Hydro	700	FURNAS	Sao Paulo
5.	Mascarenhas de Morais	Hydro	477	CPFL	Minas Gerais
6.	Henry Borden 1/	Hydro	474	LIGHT	Sao Paulo
7.	Jaguara	Hydro	456	CEMIG	Minas Gerais
8.	Piratininga	Thermal	410	LIGHT	Sao Paulo
9.	Xavantes	Hydro	400	CESP	Sao Paulo
10.	Henry Borden 2/	Hydro	390	LIGHT	Sao Paulo
11.	Tres Marias	Hydro	388	CEMIG	Minas Gerais
12.	Nilo Pecanha	Hydro	330	LIGHT	Rio de Janeiro
13.	Capivari-Cachoeira	Hydro	253	COPEL	Parana
14.	Funil	Hydro	210	FURNAS	Rio de Janeiro
15.	Ilha dos Pombos	Hydro	162	LIGHT	Rio de Janeiro
16.	Santa Cruz	Thermal	160	FURNAS	Guanabara
17.	Fontes	Hydro	154	LIGHT	Rio de Janeiro
18.	Jacui	Hydro	150	CEEERS	Rio Grande do Sul
19.	Cachoeira Dourada	Hydro	136	CELG	Goias
20.	Alvaro S. Lima	Hydro	124	CESP	Sao Paulo
21.	Barra Bonita	Hydro	122	CESP	Sao Paulo
22.	Ibitinga	Hydro	114	CESP	Sao Paulo
23.	Castelo Branco	Hydro	108	COHEBE	Piaui
24.	Salto Grande	Hydro	104	CEMIG	Minas Gerais
25.	Jorge Lacerda	Thermal	100	ELETROSUL	Santa Catarina

1/ Outdoor.
2/ Underground.

SELF-PRODUCERS, 1955-70[1/]

Year	Installed Capacity (MW)			Generation (GWh)			Consumption (GWh)
	Hydro	Thermal	Total	Hydro	Thermal	Total	
1955	217	100	317	820	303	1,123	936
1956	197	101	298	846	333	1,179	1,041
1957	194	147	341	888	468	1,356	1,252
1958	202	165	367	995	473	1,468	1,273
1959	220	148	368	1,000	482	1,482	1,404
1960	225	233	458	1,045	558	1,603	1,549
1961	259	306	565	1,113	740	1,853	1,554
1962	297	413	710	1,273	936	2,209	1,846
1963	350	469	819	1,343	1,072	2,415	2,030
1964	346	488	834	1,406	1,194	2,600	2,236
1965	334	488	822	1,640	1,021	2,661	2,341
1966	329	553	882	1,592	1,188	2,780	2,473
1967	344	560	904	1,746	1,214	2,960	2,627
1968	347	523	870	1,750	1,170	2,920	2,644
1969	348	561	909	1,697	1,175	2,872	2,609
1970	355	594	949	1,738	1,686	3,424	3,146

1/ This table shows conservative figures when compared to those of ELETROBRAS as the latter's survey of self-producers is of a larger scope than DNAEE's.

Source: DNAEE.

REGIONAL[1] CONSUMPTION, ACTUAL (1969-71) AND FORECAST (1972)

(GWh)

	Year	Main Utilities[2] North	Northeast	Southeast	West Central	South	Sub-Total	Other Utilities	Self Producers	Total Brazil
Actual	1969								3,460	34,433
	1970	338	3,043	26,778	577	3,184	33,920	509	3,760	38,183
	1971[3]	390	3,435	30,639	714	3,545	38,724	580	3,625	42,929
Forecast	1972	464	4,269	33,756	910	4,167	43,568	653	3,878	48,099
	1973	563	5,213	37,249	1,137	4,752	48,915	735	4,150	53,800
	1974	647	6,528	41,171	1,431	5,350	55,127	828	4,440	60,395
	1975	740	7,749	45,269	1,705	6,017	61,481	932	4,751	67,164
	1980	1,550	19,280	71,260	4,610	9,600	106,300	1,685	6,660	114,645
	1985	4,490	44,100	113,720	11,000	15,180	188,490	3,050	9,350	200,890
Average Annual Growth	1971-75	17.4%	22.6%	10.3%	24.4%	14.1%	12.3%	12.6%	7.0%	11.9%
	1975-80	16.0%	20.0%	9.5%	22.0%	9.8%	11.6%	12.6%	7.0%	11.3%
	1980-85	15.0%	18.0%	9.8%	19.0%	9.6%	12.1%	12.6%	7.0%	11.9%

1/ Where necessary, markets of utilities have been split between geographical regions.
2/ 66 main utilities involved in distribution surveyed by ELETROBRAS.
3/ Estimate made by ELETROBRAS in mid-1971.

EXPECTED REGIONAL GROSS GENERATION, NATIONAL CONSUMPTION AND LOSSES, 1971-75

ear	GENERATION (GWh)									CONSUMPTION	LOSSES
	Main Utilities										
	North	North-east	South-east	West Central	South	Sub-Total	Small 1/ Utilities	Self 1/ Producers	Total 1/ Brazil	(GWh)	% of (Generation
971	528	4,560	36,429	1,244	4,719	47,479	290	3,770	51,539	42,929	16.7
972	602	5,518	41,059	1,487	5,145	53,812	226	4,033	58,071	48,099	17.2
973	714	6,666	45,256	1,909	5,713	60,258	367	4,316	64,941	53,800	17.1
974	809	8,231	50,185	1,967	6,344	67,537	414	4,618	72,569	60,395	16.8
975	926	9,727	54,704	2,615	7,180	75,153	466	4,941	80,560	67,164	16.6

/ Estimated.

ource: ELETROBRAS.

REGIONAL POWER SUPPLY AND EXPANSION PROGRAMS[1/]

North Region

1. The consumption of the North region represented only about one percent of Brazil's total and the regional per capita consumption, 117 kWh in 1971, is the lowest in the country. The average annual rate of growth over the period 1967-71 was 18 percent. The consumption is mostly based on residential and commercial activities and is composed of isolated centers since there is no case for interconnection at the moment. The main load centers are the cities of Manaus and Belem.

2. In Manaus the local utility is the formerly private Companhia de Eletricidade de Manaus (CEM), now a subsidiary of ELETROBRAS. It has a total installed capacity of about 45 MW, comprising thermal and diesel installations. A 50 MW steam generating plant is now under construction to be commissioned in 1973. ELETROBRAS is now considering financing an extension of 100 MW of the latter for operation by 1976. This would carry the system load through 1980.

3. Power supply in Belem is provided by Centrais Eletricas do Para (CELPA), owned by the state of Para and which has now an 80 MW steam generating plant and a 22 MW diesel plant in operation. A new 50 MW steam generating plant financed by ELETROBRAS, will be commissioned in 1974. The other load centers are small and are supplied by small generally state-owned diesel plants. Among those cities are Santarem, served by CELPA, Macapa in the state of Amapa, served by the Companhia de Eletricidade do Amapa (CEA) owned by the Federal Government, Boa Vista in the state of Roraima, served by Centrais Eletricas de Roraima, S.A. (CER), Rio Branco in the state of Acre, served by Companhia de Eletricidade do Acre, S.A. (ELETROACRE), and Itacoatiara in the Amazon state, served by the state-owned Centrais Eletricas do Amazonas, S.A. (CELETRO-AMAZON).

4. A coordinating committee set up for the purpose of investigating the possibility of hydroelectric developments in the region made an inventory of potential hydro sites in January 1972, (Annex 12). Some of these hydro projects may be considered for development for operation after 1980 but no details are as yet available.

Northeast Region

5. The Northeast region consumes almost 10 percent of the national consumption and contains 30 percent of the population, resulting in the

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1/ See four maps attached (a) North and West Central; (b) Northeast; (c) Southeast; and (d) South.

low per capita consumption of 140 kWh. About 44 percent of the consumption is by industry. Power for the Northeast is mainly supplied by two bulk supply companies, both ELETROBRAS subsidiaries, which sell power to distributing companies. The largest is the Companhia Hidroeletrica do Sao Francisco (CHESF) which serves seven states. CHESF itself sells only 5 percent of its generation to final consumers, mostly industrial. CHESF's generating capacity consists of the 821 MW Paulo Afonso hydroelectric plant on the Sao Francisco river and other minor generating facilities. The other bulk supplier, serving the western part of the region, is Companhia Hidroeletrica da Boa Esperanca (COHEBE), which owns the 108 MW Castelo Branco[1/] hydroelectric plant. The largest distributing company in the region is the Companhia de Eletricidade de Pernambuco (CELPE), owned by the state of Pernambuco. CELPE purchases power from CHESF. In the state of Bahia, power is supplied to the city of Salvador by Companhia de Energia Eletrica da Bahia (CEEB), a distributing company of ELETROBRAS. The rest of the state is served by the state-owned Companhia de Eletricidade do Estado da Bahia (COELBA) which owns the 30 MW Funil hydroelectric plant on the Rio Contas in the south of the state and a number of smaller plants, mostly diesel. Both these companies purchase power in bulk from CHESF. There is a small separate system in the southwestern part of the state supplied by the 4 MW Correntina hydroelectric plant on a tributary of the Sao Francisco river. Other state-owned main concessionaires include Sociedade Anonima de Eletrificacao da Paraiba (SAELPA), Companhia de Eletricidade de Alagoas (CEAL) and Companhia de Servicos Eletricos do Rio Grande do Norte (COSERN), all three distributing companies supplying the states of Paraiba, Alagoas and Rio Grande do Norte, respectively. In the western part of the region, the city of Fortaleza in the state of Ceara is supplied by Companhia Nordeste de Eletrificacao de Fortaleza (CONEFOR) a distributing company subsidiary of ELETROBRAS.

6. The Ministry of Mines and Energy, by Decree No. 65237 of September 26, 1969, established a coordinating committee (Comite Coordenador dos Estudos Energeticos do Nordeste), headed by ELETROBRAS to formulate a development plan for the Northeast. In 1970 this Committee initiated a power inventory/planning study, conducted by ELETROBRAS. In this region most of the generating capacity additions are by the federal company CHESF. CHESF has hired SOFRELEC to make a feasibility study of stage IV of Paulo Afonso project and the related transmission system. Because of the great distances involved a 400 KV system is being planned to overlay the present 230 KV system. Final reports were expected to be completed in the fall of 1972. The long-term power development program in this region is based on the development of the Sao Francisco river with its characteristic large-size, low-cost hydroelectric sites. The Paulo Afonso hydroelectric site on the Sao Francisco river is currently being developed in stages. The first three stages with an aggregate capacity of 824 MW will be completed before 1974. ELETROBRAS has ordered

1/ Formerly called Boa Esperanca.

additional needs of metallurgical development in the central area of the state, CELG's 230 KV transmission system is being extended northwards and joint studies are being undertaken by ELETROBRAS and CELG to select a suitable hydroelectric project on the upper Tocantins river or its tributaries. Construction is expected to start around 1975, and operation by the end of this decade.

Southeast Region

10. Consumption in the Southeast represented about 80 percent of the national total and per capita use was about 800 kWh in 1971, almost twice Brazil's average. The main concessionaires, their functions and area of service are shown in Annex I. The total capacity in this Region by end 1971 was 8,400 MW, about 75 percent of the total in the country. The present power supply situation is comfortable with the hydroelectric reservoirs -- two of them, viz.FURNAS and TRES MARIAS, with large carry-over storage capacities -- being full in March 1972 after passing through 1971, a critical year when Rio Grande and Sao Francisco riverflows fell to 40 percent of those of the historical worst year. Prudent intersystem coordination resolved a difficult situation in 1971 with no restrictions in power supply. Two major new hydroelectric projects on the Rio Grande river -- Volta Grande and Porto Colombia -- with a total capacity of 800 MW, are due for commissioning in 1973 and 1974, to be followed, in 1974, by the 3,200 MW Ilha Solteira project on the Parana, and in 1975-76 by the 1,400 MW Marimbondo Project, (Rio Grande). The 270 MW Promissao (Tiete river) and the 640 MW Capivara (Paranapanema river) hydroelectric projects are also expected to be commissioned by 1976. A 620 MW nuclear power station is being constructed by FURNAS at Angra for commissioning around 1976-77. Needed expansion of Rio and Sao Paulo and other distribution systems is under way. By and large, this program of expansion can meet the presently anticipated growth in demand until 1978, provided that the power systems are pooled. Efforts are being made by ELETROBRAS and the main power companies to this end.

11. To meet the growth of demand towards the end of the decade, three hydroelectric projects: Sao Simao on the Paranaiba river -- 2,500 MW; Itumbiara on the Paranaiba river -- 2,080 MW; and Agua Vermelha on the Rio Grande river -- 1,380 MW -- are under construction or planned. ELETROBRAS is currently engaged on detailed market and power studies to update the power development plans for the entire Southeast Region. In this context the need for thermal stations up to about 1,000 MW of aggregate capacity during this period, is to be reviewed. ELETROBRAS has also initiated studies aimed at strengthening the transmission link between the Southeast and South Regions to exchange surpluses and take advantage of the natural diversities in the hydrological characteristics of the rivers of these two regions.

12. Other than Sete Quedas, a site located on the international stretch of the Parana (between Brazil and Paraguay), the only significant undeveloped hydroelectric sites available, to meet power demands of the

early eighties are those identified by the CANAMBRA study in the Upper Paranaiba Valley and at Ilha Grande on the Parana. CEMIG's recent investigations revealed that the costs of development of the sites in the Upper Paranaiba Valley are significantly higher than estimated by CANAMBRA and do not appear very promising. Extensive flooding of upstream arable land is the main problem at Ilha Grande. Thermal/nuclear alternatives employing large-size units of 500/1,000 MW, with complementary peaking hydro capacity, and pumped storage, peaking hydro alternatives are available along the western escarpment in this Region close to the main demand centers and are being investigated by the major power utilities.

12. Sete Quedas is the largest hydroelectric scheme conceived by Brazil so far, and is estimated to cost about US$2,000 million for a 12,000 MW installation and associated transmission facilities. It is currently under investigation by ELETROBRAS of Brazil and ANDE of Paraguay under international agreement of the two countries. If this scheme is taken up for implementation around 1974, it could by itself meet the entire growth of demand in the Southeast region well into the eighties. About 87 percent of the firm potential of Sete Quedas project, estimated at about 6,500 MW at 100 percent load factor, has been tentatively reserved for the Southeast region. With the average demand at the end of 1980 reaching 10,000-11,000 MW and increasing thereafter at about 9 percent annually, the potential of Sete Quedas could be utilized, within about 5 years of the date of commissioning of the first unit, assumed to be around 1982.

South Region

14. The South Region consumed about 10 percent of the national total and the per capita use was 270 kWh in 1971. The main concessionaires, their functions and area of service are shown in Annex I. Total installed capacity in the region at the end of 1971 was 1,320 MW. The demand for power during 1970 and 1971, at 490 MW and 530 MW (average), respectively, has been below the CANAMBRA forecasts mainly because expected heavy industrial development did not materialize. ELETROSUL, the federal company which has been established to develop the major power resources of regional importance, started operations with the acquisition of three thermal plants SOTELCA, Charqueadas and Alegrete. In addition the 220 MW Passo Fundo hydroelectric station is expected to come into service in 1972. Also under construction are the 100 MW Candiota thermal plant for 1974, and the 700 MW Salto Osorio hydroelectric plant for 1975. The construction of the 400 MW Itauba hydroelectric plant has been recently authorized for commissioning by 1976. One of the problems of power supply is the high cost of fuel, mainly coal, at the three thermal power stations. The coal tariff is designed to support the colliery and metallurgical industries of the area.

15. Based on their findings that Iguacu river has the cheapest sources of hydro power in the region, and that the least cost source of thermal power was at the Candiota collieries (where the cost of coal was about one-fourth of those from other coal-bearing areas), the CANAMBRA study recommended the following expansion program:

(i) one 100 MW unit at Candiota - 1978;

(ii) initial commissioning of Santo Santiago (4 x 170 MW) - 1978.

The concession for development of the Santo Santiago site has been awarded recently to ELETROSUL. A proposal is now under active consideration for ELETROSUL to install two thermal units of 125 MW at SOTELCA and not CANDIOTA in order to utilize the by-products from the production of metallurgical coal for Brazil's steel industry. The Santo Santiago project is to be postponed by 2 years, if this plan is adopted. There is some doubt whether the proposed thermal plant is justified and should be constructed. The matter is under review.

16. Apart from the Iguacu River -- which has a good undeveloped storage site (Lanza) and a major power station site (Segredo) for future development -- CANAMBRA identified no other sites in the South region which can be developed at competitive cost. This excludes two trans-basin diversion proposals with a potential of about 1,500 MW, which have been kept in abeyance because they may have international implications. The Iguacu developments mentioned above could be completed to meet demand up through 1982, but thereafter, the region would have to rely on Sete Quedas. According to present plans about 13 percent of Sete Quedas' power would be reserved for the needs of South region, meeting demand from 1982 through 1985.

YEARLY GENERATING CAPACITY ADDITIONS, 1971-76

(MW)

[illegible] Plant	Type	Installed Generating Capacity Additions						
		1971	1972	1973	1974	1975	1976	After 1976
[illegible]-REGION		51.3	40.4	80.3	51.4	102.9	100.0	2,768.0
[illegible], Manaus	Thermal	7.5	-	-	-	-	-	-
[illegible]	Thermal	9.4	-	-	-	-	-	-
[illegible] (New Plant)	Thermal	-	-	40.0	-	100.0	-	-
[illegible] Belem	Thermal	10.2	10.2	-	-	-	-	-
[illegible]	Hydro	-	-	10.0	10.0	-	-	-
[illegible]	Thermal	-	-	25.0	-	-	100.0	-
[illegible] Tunas (Paraopeba)	Hydro	-	-	-	40.0	-	-	-
[illegible] (Rondonia)*	Hydro	-	-	-	-	-	-	60.0
[illegible] (Amazonas-Manaus)*	Hydro	-	-	-	-	-	-	148.0
[illegible] (Amazonas)*	Hydro	-	-	-	-	-	-	120.0
[illegible] (Para)*	Hydro	-	-	-	-	-	-	2,460.0
Small Plant		24.2	30.2	5.3	1.4	2.9	-	-
NORTHEAST REGION		210.1	414.2	260.4	22.0	100.0	610.0	6,706.0
Paulo Afonso III	Hydro	206.0	412.0	206.0	-	-	-	-
[illegible] Castelo Branco	Hydro	-	-	54.0	-	-	-	-
Pedras	Hydro	-	-	-	20.0	-	-	-
[illegible]	Hydro	-	-	-	-	100.0	300.0	-
Paulo Afonso IV	Hydro	-	-	-	-	-	310.0	1,550.0
[illegible]	Hydro	-	-	-	-	-	-	1,056.0
[illegible]	Hydro	-	-	-	-	-	-	4,100.0
Small Plant		4.1	2.2	0.4	-	-	-	-
WEST CENTRAL REGION		15.2	53.0	80.7	187.2	23.0	-	580.0
Cesca III	Hydro	8.2	-	-	4.2	-	-	-
Cachoeira Dourada	Hydro	-	50.0	80.0	160.0	-	-	-
Mimoso	Hydro	-	-	-	23.0	23.0	-	-
Couto de Magalhaes*	Hydro	-	-	-	-	-	-	180.0
Ninehandia*	Hydro	-	-	-	-	-	-	400.0
Small Plant		7.0	3.0	0.7	-	-	-	-
SOUTHEAST REGION		973.0	969.5	1,255.0	1,413.2	1,082.0	1,590.0	7,175.0
Estreito	Hydro	-	350.0	-	-	-	-	-
Jupia	Hydro	300.0	100.0	200.0	-	-	-	-
Xavantes	Hydro	200.0	-	-	-	-	-	-
Jaguara	Hydro	456.0	-	-	-	-	-	-
Santa Cruz II	Thermal	-	400.0	-	-	-	-	-
Alegrim	Hydro	-	72.0	-	-	-	-	-
Raplan	Thermal	-	22.5	-	-	-	-	-
Volta Grande	Hydro	-	-	220.0	220.0	-	-	-
Porto Colombia	Hydro	-	-	80.0	240.0	-	-	-
Jaguari	Hydro	-	24.0	-	-	-	-	-
Mascarenhas	Hydro	-	-	120.0	-	-	-	-
Ilha Solteira	Hydro	-	-	480.0	600.0	640.0	480.0	800.0
Furnas	Hydro	-	-	150.0	150.0	-	-	-
Paraibuna	Hydro	-	-	-	-	86.0	-	-
Promissao	Hydro	-	-	-	-	180.0	90.0	-
Marimbondo	Hydro	-	-	-	-	175.0	700.0	525.0
Angra	Nuclear	-	-	-	-	-	-	620.0
Capivara	Hydro	-	-	-	-	-	320.0	320.0
CESP Thermal Plant	Thermal	-	-	-	-	-	-	600.0*
Itumbiara	Hydro	-	-	-	-	-	-	1,070.0
Sao Simao	Hydro	-	-	-	-	-	-	1,500.0
CEMIG Thermal Plant	Thermal	-	-	-	-	-	-	360.0*
Agua Vermelha	Hydro	-	-	-	-	-	-	1,380.0
Small Plant		17.0	1.0	5.0	3.0	-	-	-
SOUTH REGION		146.5	1.5	614.4	-	535.0	375.0	11,105.0
Capivari-Cachoeira	Hydro	125.0	-	-	-	-	-	-
Chiriana	Hydro	16.5	-	-	-	-	-	-
Jorge Lacerda	Thermal	-	-	132.0	-	-	-	25.0
Passo Fundo	Hydro	-	-	220.0	-	-	-	-
Porto (Pelotas)	Thermal	-	12.5	-	-	-	-	-
Passo Real	Hydro	-	-	125.0	-	-	-	-
Candiota II	Thermal	-	-	132.0	-	-	-	100.0
Figueira	Thermal	-	-	10.0	-	-	-	-
Itauba	Hydro	-	-	-	-	-	200.0	200.0
Salto Osorio	Hydro	-	-	-	-	535.0	175.0	-
Santiago	Hydro	-	-	-	-	-	-	680.0*
Itaipu (Sete Quedas)	Hydro	-	-	-	-	-	-	10,000.0*
Small Plant	Hydro	5.0	-	-	-	-	-	-
GRAND TOTAL		1,396.1	1,489.6	2,295.4	1,671.6	1,841.9	2,675.0	28,354.0

* Projects under study.
Source: ELETROBRAS/OPE.

YEARLY INVESTMENTS IN GENERATION, TRANSMISSION, DISTRIBUTION AND OTHERS, 1966-75[1/]

(In Cr$ million of June 1971/US$1 = Cr$5,285)

	Actual					Forecast					Totals			
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1966-70		1971-75	
Generation	1,301	1,873	1,895	2,186	2,347	2,718	3,406	3,299	3,821	3,895	9,602	(56%)	17,139	(57%)
Transmission	590	686	845	879	938	1,145	1,650	1,475	1,288	1,475	3,938	(23%)	7,033	(23%)
Distribution	369	441	518	597	743	753	804	857	914	1,041	2,668	(15%)	4,369	(15%)
Others	180	197	217	207	294	341	334	328	287	269	1,095	(6%)	1,559	(5%)
Total	2,440	3,197	3,475	3,869	4,322	4,957	6,194	5,959	6,310	6,680	17,303	(100%)	30,100	(100%)
Annual Growth		31.0%	8.7%	11.3%	11.7%	14.7%	24.9%	3.9%	5.9%	5.9%				
Average Growth	----------					11.8%				----------				

1/ Excluding interest during construction.

Source: ELETROBRAS/OPE 1971-75/Revised.

YEARLY INVESTMENTS, REGIONWISE, 1971-75[1/]

(In Cr$ million of June 1971, US$1.00 = Cr$5.285)

	1971	1972	1973	1974	1975	Total 1971/1975
GENERATION						
North	131	168	155	197	225	876
Northeast	163	264	477	517	468	1,889
West Central	29	39	54	69	152	343
Southeast	2,006	2,437	2,311	2,797	2,849	12,400
South	389	498	302	241	201	1,631
Total	2,718	3,406	3,299	3,821	3,895	17,139
TRANSMISSION						
North	3	5	5	5	5	23
Northeast	113	96	201	185	185	780
West Central	21	38	38	36	42	175
Southeast	364	667	506	423	456	2,416
South	70	88	78	76	168	480
Total	571	894	828	725	856	3,874
SUBSTATIONS						
North	6	4	3	6	7	26
Northeast	136	139	174	141	128	718
West Central	14	35	38	25	32	144
Southeast	335	466	360	323	362	1,846
South	83	111	72	68	91	425
Total	574	755	647	563	620	3,159
DISTRIBUTION						
North	19	19	19	20	21	98
Northeast	113	114	122	134	151	634
West Central	25	42	39	43	45	194
Southeast	531	536	659	581	677	2,894
South	65	93	108	136	147	549
Total	753	804	857	914	1,041	4,369
OTHERS						
North	5	7	6	6	5	29
Northeast	58	68	54	57	60	297
West Central	6	9	5	5	5	30
Southeast	237	214	222	180	159	1,012
South	35	36	41	39	40	191
Total	341	334	328	287	269	1,559
TOTAL INVESTMENT						
North	164	203	188	234	263	1,052
Northeast	583	681	1,028	1,034	992	4,318
West Central	95	163	174	178	276	886
Southeast	3,473	4,320	3,968	4,304	4,503	20,568
South	642	826	601	560	647	3,276
TOTAL	4,957	6,193	5,959	6,310	6,681	30,100

1/ Excluding interest during construction.

Source: ELETROBRAS, OPE 1971-75, revised.

LIST OF PROJECTS FOR EXTERNAL FINANCING: POWER SECTOR

Project	MW	Executing Agency	Estimated Total Cost	Direct Foreign Procurement	External Financing Sought	Probable Commitment Date	Disbursement Period	Prospective Lender + Status of Project
1. Itauba Hydroelectric	400	CEEE	130	20	50	1972	1973-81	Supplier (b)
2. Itumbiara Hydroelectric	2,080	FURNAS	550	100	220	1973	1973-81	IBRD (b)
3. Agua Vermelha Hydroelectric	1,380	CESP	400	60	120	1973	1972-78	IBRD (b)
4. Santiago Hydroelectric	712	ELETROSUL	190	23	70	1974	1974-79	IBRD (d)
5. Sao Paulo Steam Plant	600	CESP	138	62	62	n.a.	n.a.	Supplier (d)
6. Belo Horizonte Thermal	360	CEMIG	82	45		1972-73	1973-76	Supplier (b)
7. Moxoto Hydroelectric	400	CHESF	202	72	60	1972	1972-76	IDB (a)
8. Paulo Afonso IV Hydroelectric	1,860	CHESF	274 1/	80	70	1973	1972-79	IDB (c)
9. Sobradinho Dam		CHESF	215	71	70	1973	1972-78	n.a. (c)
10. Floating Units for Emergency		ELETROBRAS	37.5	30	30	1972	1972-73	Eximbank (b)
11. Tapana Belem Thermal	100	CELPA/ELETROBRAS	20	15	15	1972	1972-75	KFW (b)
12. Manaus II Thermal	100	CFM/ELETROBRAS	20	15	15	1972	1972-75	Eximbank (b)
13. Distribution of Light, S.A.		Light, S.A.	654	73	105	1972	1972-76	IBRD + Supplier (b)
14. Sete Quedas	10,500	ELETROBRAS	2,000	n.a.	n.a.	1972-74	n.a.	n.a. (d)
15. Couto de Magalhaes	180	ELETROBRAS	55 1/	n.a.	n.a.	1973	1973-79	n.a. (d)

1/ Excluding transmission.

Explanations: (a) Project already under negotiation for external assistance.
(b) Project in an advanced stage of preparation and due for early presentation for external assistance.
(c) Project under study and would be ready for presentation to external financing agency by 1974.
(d) Other than above.

BRIEF DESCRIPTION OF PROJECTS FOR EXTERNAL FINANCING[1/]

1. Investments in this sector are programmed and coordinated by ELETROBRAS. Although the projects listed below conform with present ELETROBRAS planning they should be regarded as tentative in the sense that a study of the power market and required investment in the Southeast is presently being carried out by ELETROBRAS.

Itauba Hydro Plant (South)

2. The concession for development of this 400 MW plant, to be located on the Jacui River in Rio Grande do Sul has been granted to Companhia Estadual de Energia Eletrica (CEEE). The plant will mainly serve the state of Rio Grande do Sul. Total cost: US$130 million. Direct foreign procurement: US$20 million. External financing: US$50 million. Probable commitment date: 1972. Estimated disbursement period: 1972-78.

Itumbiara Hydroelectric Project (Southeast)

3. This is a major hydro storage scheme on the Paranaiba river for which the concession has been granted to Furnas Centrais Eletricas, S.A. (FURNAS). The plant will have an installed capacity of 2,080 MW (8 x 260 MW) and the scheme would afford additional firm potential, through its water releases, to downstream power stations. It would thus help meet demands of the Southeast region and its adjoining areas after 1978. An economic feasibility study has been completed. Engineering studies are in progress. The total cost, including transmission lines has been estimated at US$550 million and the external financing required is US$220 million. Probable commitment date: 1973. Estimated disbursement period: 1973-81.

Agua Vermelha Hydroelectric Project (Southeast)

4. The Agua Vermelha plant, with a planned capacity of 1,380 MW (6 x 230 MW), will be located in the lower course of the Rio Grande some 550 km from the Sao Paulo metropolitan area. The project will supply the Southeast power market from 1979. Total cost, including transmission lines, estimated: US$400 million. External financing: US$120 million. Probable commitment date: 1973. Estimated disbursement period: 1973-81. Executing Agency: Centrais Eletricas de Sao Paulo (CESP).

Santiago Hydroelectric Project (South)

5. A storage project upstream of the Salto Osorio plant, currently under construction, comprises a dam and a 712 MW (4 x 178 MW) power station on the Iguacu river in the State of Parana and associated transmission facilities. A concession for development of the site has been recently granted to Centrais Eletricas do Sul do Brasil, S.A. (ELETROSUL).

1/ This part of Annex 14 to be incorporated later in Main Economic Report.

The project would help meet the power demand in the southern region from 1980. Total estimated cost: US$190 million. External financing: US$70 million. Probable commitment date: 1974. Estimated disbursement period: 1974-79.

Sao Paulo Steam Plant (Southeast)

6. This project, with a capacity of 600 MW, was considered as a possible means of providing additional power in the Sao Paulo area during 1974-75 prior to the completion of the 3,200 MW Ilha Solteira hydro plant which is scheduled for commissioning in 1974. Its estimated cost is US$110 million and the external financing required is US$62 million. The scheme has not been authorized for construction. The need for this interim solution will be reviewed by ELETROBRAS in the context of preparation of an updated development plan for the Southeast region, by the end of December 1972.

Belo Horizonte Thermal Plant (Southeast)

7. This scheme of installing a 360 MW thermal station at Belo Horizonte which was not included in the CANAMBRA plan, was proposed by Centrais Eletricas de Minas Gerais, S.A. (CEMIG) to meet interim shortages in Minas Gerais during 1976-77. The estimated cost was US$65 million and the external financing required is US$45 million. The need for this station is currently under review in the context explained in para. 6.

Moxoto Hydroelectric Plant (Northeast)

8. This new plant will have an initial capacity of 400 MW (4 x 100 MW) and will be located upstream from the existing Paulo Afonso plant on the Sao Francisco River. It will provide better regulation of the stream at Paulo Afonso. In conjunction with the Stage IV Paulo Afonso project (10) and the Sobradinho dam project to augment storage capacity for hydroplants on the Sao Francisco River (11), the Moxoto project will be essential for meeting Northeast region power demand by 1977. Economic feasibility studies have been completed and SOFRELEC is assisting with the engineering studies. Inter-American Development Bank financing is envisaged. The total cost has been estimated at US$202 million and external financing required is US$60 million. Probable commitment date: 1972. Estimated disbursement period: 1972-76. The Executing Agency would be Companhia Hidro Eletrica do Sao Francisco (CHESF).

Paulo Afonso (IV) Hydroelectric Project (Northeast)

9. This fourth stage of the Paulo Afonso hydroelectric complex consists of expansion of the underground generation plant by 1,860 MW (6 x 310 MW) using the storage capacity of Sobradinho dam (10). This project is to be commissioned during 1976-80. The economic feasibility study has been completed and CHESF is engaged in detailed engineering studies with the assistance of SOFRELEC. Bank financing for the project is being considered. The estimated cost is US$274 million for power

generation alone and the external financing required is US$70 million. Probable commitment date: 1972. Estimated disbursement period: 1973-80. The Executing Agency would be Companhia Hidro Eletrica do Sao Francisco (CHESF).

Sobradinho Dam (Northeast)

10. This storage project on the Sao Francisco River will support both the existing Paulo Afonso complex and enable its fourth stage expansion. Inter-American Development Bank financing is envisaged. Total cost: US$215 million. External financing: US$70 million. Probable commitment date: 1972. Estimated disbursement period: 1972-78. Executing Agency: Companhia Hidro Eletrica do Sao Francisco (CHESF).

Floating Gas Turbine Units for Power Emergencies (Northeast)

11. This project is designed to meet emergency requirements for power in the Northeast and possibly Belem. Two non self-propelled barges will be equipped with 130 MW of gas turbine generating capacity and stationed alternatively at the Bahia industrial center (Aratu), Recife, Fortaleza or Belem as requirements dictate. Feasibility studies are being undertaken by ELETROBRAS with the consulting assistance of EBASCO Services Inc. Eximbank financing is envisaged. Total cost: US$37.5 million. External financing: US$30 million. Probable commitment date: 1972. Estimated disbursement period: 1972-73. Executing Agency: Centrais Eletricas Brasileiras, S.A. (ELETROBRAS).

Tapana - Belem Thermal Project (North)

12. This 100 MW (3 x 50 MW) oil-fired steam turbine project will meet Belem area demand when obsolete diesel units are removed. The demand for power around Belem has been increasing at a 26.6 percent annual pace and modernization of the existing generating facilities is overdue. Total cost: US$20 million. External financing: US$15 million. Probable commitment date: 1972. Estimated disbursement period: July 1972 - December 1975. Executing Agencies: Centrais Eletricas do Para, S.A. (CELPA) and ELETROBRAS.

Manaus Thermal Project (North)

13. Energy consumption in Manaus is expanding by 19.9 percent annually. 100 MW (2 x 50 MW) in oil-fired steam turbine generating capacity will be added by this project to the Manaus diesel generation system. Feasibility studies are nearing completion. Total cost: US$20 million. External financing: US$15 million. Probable commitment date: 1972. Estimated disbursement period: July 1972-December 1975. Executing Agencies: Companhia de Eletricidade de Manaus (CEM) and ELETROBRAS.

Transmission and Distribution Project of Light, S.A.
(Sao Paulo and Rio de Janeiro Metropolitan Areas)

14. This five-year project is designed to meet anticipated growth in the load carried by the transmission and distribution system of Light - Servicos de Eletricidade, S.A., which serves Rio and Sao Paulo metropolitan areas. As of end-1971, Light had 3,265,000 connected customers in a service area of some 16,400,000 total population. Projections indicate that by end-1976 the number of customers will be 4,400,000. Peak load is expected to grow from 3,960 MW in 1971 to approximately 6,000 MW in 1976.

15. In order to meet this load growth and to serve existing and new consumers in a satisfactory manner, it is estimated that it will be necessary to add to the company's electric system:

- 384 circuit km of 345/230 kv transmission;
- 253 circuit km of 132 kv transmission;
- 391 circuit km of 88 kv transmission;
- 3,280 MVA of 345/230 - 345/132 - 230/88 kv transformation;
- 1,723 MVA of 132-25/13.2/6 kv transformation;
- 2,026 MVA of 88-33/20/13.2 kv transformation;
- 2,812 MVA of overhead and underground distribution transformers.

A feasibility study is completed. Financing is sought from both bilateral and multilateral sources. Total cost: US$654 million. External financing: US$105 million. IBRD prospective loan: US$20 million. Probable commitment date: 1972. Estimated disbursement period: 1972-76. Executing Agency: Light - Servicos de Eletricidade, S.A.

Sete Quedas Hydroelectric Project

16. At the end of 1971 installed power generation capacity in Brazil was 12.6 million kW. Brazil's power market is expected to grow by 12 percent annually during 1970's. About 85-90 percent of this would be in the Southeast and South regions. Schemes under construction and planning described above would meet requirements until 1980. ELETROBRAS has under study alternatives for energy development to meet the requirements of the 1980's. One alternative would be a series of thermal plants including nuclear facilities. Another alternative is the international development, with Paraguay, of the hydroelectric potential of the Parana River at the Sete Quedas falls. Here the river flows through a narrow canyon falling 100 m to Porto Mendes and a further 20 m from Porto Mendes to Foz do Iguacu. The generating potential in these stretches is around 6,500 MW at 100 percent load factor and could be utilized in South and Southeast Brazil within 4-5 years of commencement of operation. The economic feasibility of the Sete Quedas project in relation to all available alternatives is under study by Brazil and Paraguay. Considering the long lead time required by this project, financing would have to be committed by 1974 in order to meet the energy requirements of the early 1980's.

Preliminary estimates indicate that the investment cost would be about US$2,000 million. Promoting Agencies: Centrais Eletricas Brasileiras, S.A. ELETROBRAS (BRAZIL) and Administracao Nacional de Eletricidade - ANDE (PARAGUAY).

Couto de Magalhaes Hydro Plant

17. This 180 MW plant, to be located on the Araguaia river on the bounderies of Mato Grosso and Goias states. This project will serve the Mato Grosso (mainly Cuiaba area) and part of Goias. Total cost: US$55 million. Foreign Exchange Component: US$14 million. Probable commitment date: 1973-74. Estimated disbursement period: 1973-74 to 1979. Executing Agency: n.a.

MINERAL COAL PRODUCTION AND IMPORTS - TOTAL CONSUMPTION (1965-71) [1]

(in 1,000 metric tons)

Year	DOMESTIC PRODUCTION				CONSUMPTION			
	RAW	PROCESSED			DOMESTIC		IMPORTS	TOTAL
		Steam	Metallurgical	Total	Steam	Metallurgical	Metallurgical	
1965	3,371	1,354	616	1,970	1,115	646	1,125	2,886
1966	3,666	1,458	675	2,133	1,088	647	1,476	3,211
1967	4,339	1,535	760	2,295	1,225	732	1,512	3,469
1968	4,828	1,571	793	2,364	1,533	803	1,634	3,970
1969	5,128	1,625	811	2,436	1,576	767	1,649	3,992
1970	5,172	1,576	785	2,361	1,565	747	1,728	4,040
1971	5,666	1,678	820	2,498	1,583	743	1,766	4,092

1/ Source: MNE-CNP/SCS

PRODUCTION AND IMPORTS OF CRUDE OIL AND DERIVATES - TOTAL CONSUMPTION OF DERIVATES 1/ (1965-70)

(In 1,000 metric tons)

Year	Crude Oil			Derivates			
	National Production	Imports	Total	National Production	Imports	Total	Consumption
1965	4,657	10,546	15,203	14,098	851	14,949	15,928
1966	5,705	11,333	17,038	16,332	935	17,267	17,120
1967	7,162	10,546	17,708	16,897	1,046	17,943	18,459
1968	7,893	12,769	20,662	19,605	2,123	21,728	21,003
1969	8,543	14,085	22,628	22,280	958	23,238	22,351
1970	8,107	15,414	23,521	24,077	1,261	25,338	23,608

1/ MNE-CNP/DE - PETROBRAS.

Source: PETROBRAS.

OIL REFINING CAPACITY

Name of Refinery	Location	m^3 Per Day
Presidente Bernardes	Municipality of Cubatao (SP)	17,617
Duque de Caxias	Municipality of Caxias (RJ)	24,000
Landulfo Alves	Municipality of Mataripe (BA)	8,268
Gabriel Passos	Municipality of Betim (MG)	7,155
Alberto Pasqualini	Municipality of Canoas (RS)	7,155
Fab. Asfalto Fortaleza ASFOR	Municipality of Fortaleza (CE)	350
Uniao - Capuava	Municipality of Sto. Andre (SP)	4,929
Manguinhos	State of Guanabara	1,590
Ipiranga	Municipality of Rio Grande (RS)	1,479
Amazonia	Municipality of Manaus (AM)	1,113
Matarazzo	Municipality of Sao Paulo (SP)	143
Riograndense	Municipality of Uruguaiana (RS)	64
	Total Existing Capacity	73,863
Paulicea 1/	Municipality of Campinas (SP)	20,000
Duque de Caxias (addition) 1/	Municipality of Caxias (RJ)	7,150
Paulicea (addition) 2/	Municipality of Campinas (SP)	20,000
n.a. 2/	State of Santa Catarina or Parana	17,000

1/ Under construction for commissioning in 1972.
2/ Under study for commissioning in 1974.

Source: Ministry of Mines and Energy/National Petroleum Council.

LIST OF 63 POWER CONCESSIONAIRES[1/] INCLUDED IN ELETROBRAS' 1971-75 CONSOLIDATED FINANCIAL PROJECTIONS

** 1. Companhia de Eletricidade de Manaus (CEM)
* 2. Centrais Eletricas do Amazonas (CELETRAMAZON)
3. Central Eletrica de Roraima (CER)
* 4. Companhia de Eletricidade do Acre (ELETROACRE)
* 5. Companhia de Eletricidade do Amapa (CEA)
* 6. Central Eletrica do Para (CELPA)
7. Central Eletrica de Rondonia (CERON)
* 8. Central Eletrica do Maranhao (CEMAR)
* 9. Central Eletrica do Piaui (CEPISA)
**10. Companhia Nordeste de Eletrificacao de Fortaleza (CONEFOR)
11. Companhia de Eletricidade do Cariri (CELCA)
12. Companhia de Eletrificacao Rural do Nordeste (CERNE)
*13. Companhia de Eletricidade do Centro Norte do Ceara (CENORTE)
*14. Companhia de Servicos Eletricos do Rio Grande do Norte (COSERN)
15. Companhia de Melhoramentos de Mossoro (COMENSA)
**16. Companhia Hidro Eletrica do Sao Francisco (CHESF)
*17. Sociedade Anonima de Eletrificacao da Paraiba (SAELPA)
18. Companhia de Eletricidade de Borborema (CELB)
19. Companhia de Eletricidade de Pernambuco (CELPE)
**20. Companhia Hidro Eletrica da Boa Esperanca (COHEBE)
21. Cooperativa de Melhoramentos de Caruaru (CARUARU)
*22. Companhia de Eletricidade de Alagoas (CEAL)
*23. Empresa Distribuidora de Energia em Sergipe (ENERGIPE)
24. Companhia Sul Sergipana de Eletricidade (SULGIPE)
**25. Companhia de Energia Eletrica da Bahia (CEEB)
*26. Companhia de Eletricidade do Estado da Bahia (COELBA)
*27. Centrais Eletricas de Sao Paulo (CESP)
**28. Companhia Paulista de Forca e Luz (CPFL)
29. Companhia Eletrica de Caiua (CAIUA)
30. Companhia Luz e Forca Santa Cruz (SANTA CRUZ)
31. Empresa de Eletricidade do Vale do Paranapanema (EEVP)
*32. Empresa Eletrica Bragantina (BRAGANTINA)
33. Companhia Prada de Eletricidade (PRADA)
34. Companhia Paulista de Eletricidade
35. Companhia Nacional de Energia Eletrica
*36. Centrais Eletricas Fluminenses (CELF)
**37. Companhia Brasileira de Energia Eletrica (CBEE)
38. Companhia Forca e Luz Ilha Branca
39. Companhia de Eletricidade de Nova Friburgo (CENF)
40. Empresa de Eletricidade Sul Paulista (EESP)
41. Companhia Paulista de Energia Eletrica (CPEE)
**42. Espirito Santo Centrais Eletricas (ESCELSA)
43. Empresa Luz e Forca Santa Maria (ELFSM)
44. Companhia Forca e Luz Cataguases-Leopoldina (CFLCL)
45. Companhia Mineira de Eletricidade (MINEIRA)
46. Departamento Municipal de Pocos de Caldas (DMPC)

*47. Centrais Eletricas de Minas Gerais (CEMIG)
*48. Eletrificacao Rural de Minas Gerais (ERMIG)
**49. Companhia Forca e Luz de Minas Gerais (CFLMG)
50. Light - Servicos de Eletricidade, S.A. (LIGHT)
**51. Furnas Centrais Eletricas, S.A. (FURNAS)
*52. Companhia Paranaense de Energia Eletrica (COPEL)
**53. Companhia Forca e Luz do Parana (CFLP)
*54. Centrais Eletricas de Santa Catarina (CELESC)
*55. Companhia Estadual de Energia Eletrica (CEEE) (RS)
**56. Companhia Pelotense de Eletricidade (CPE)
57. UTE Servicos de Eletricidade (UTE)(SC)
58. Empresa Eletrica de Londrina (LONDRINA)
59. Companhia Hidro Eletrica de Paranapanema
**60. Centrais Eletricas do Sul do Brazil (ELETROSUL)
*61. Centrais Eletricas Matogrossenses (CEMAT)
*62. Centrais Eletricas de Goias (CELG)
63. Centrais Eletricas de Brasilia (CEB)

1/ ** ELETROBRAS' 13 subsidiaries.
ELETROBRAS' Associates.

FORECAST SOURCES AND APPLICATIONS OF FUNDS 1971-75: WHOLE SECTOR

(In million of cruzeiros $ of mid-1971/US$1 = Cr$5,285)

Year Ending December 31:	1971	1972	1973	1974	1975	Total
SOURCES						
Internal Sources						
Power Concessionaires						
Cash Generation	1,098	936	1,440	1,675	1,775	6,924
Compulsory Loan	735	723	855	1,017	1,152	4,482
Reversion Fund	275	680	958	1,112	1,246	4,271
ELETROBRAS Cash Generation	625	818	845	923	925	4,136
Reinvestment of Dividends	426	548	629	761	920	3,284
Sole Tax	553	909	1,015	1,109	1,209	4,795
Total Internal Sources	3,712	4,614	5,742	6,597	7,227	27,892
External Sources						
State Governments' Contributions	580	474	510	460	439	2,463
Federal Government's Contributions	82	117	93	56	20	368
Fiscal Incentives	54	7	-	19	30	110
Other	403	276	49	44	40	812
Borrowings						
IBRD	493	438	233	194	154	1,512
IDB	276	278	131	63	3	771
USAID	159	173	30	34	-	396
KFW	36	88	12	7	-	143
EXIMBANK	27	22	2	-	-	51
Suppliers' Credit	239	266	153	71	36	765
Others	352	177	23	4	3	559
To be Sought - Foreign	-	-	473	684	861	2,018
- Local	-	631	133	176	-	940
Total Borrowings	1,582	2,093	1,190	1,233	1,057	7,155
Total External Sources	2,701	2,967	1,842	1,812	1,586	10,908
TOTAL SOURCES	6,413	7,581	7,584	8,409	8,813	38,800
APPLICATIONS						
Investments - Foreign Funds	905	1,224	1,252	1,398	1,367	6,146
- Local Funds	4,053	4,940	4,677	4,892	5,395	23,957
Debt Service	1,127	1,325	1,443	1,859	1,717	7,471
Increase in Working Capital	328	92	212	260	334	1,226
TOTAL APPLICATIONS	6,413	7,581	7,584	8,409	8,813	38,800

SOURCES AND APPLICATIONS OF FUNDS: ELETROBRAS

1971-75

SOURCES	In million Cr$
Dividends Received	1,933
Interest on Loans	3,141
Amortization of Loans	2,059
Sales of Shares to the Public	8
Others	24
TOTAL SOURCES	7,165
APPLICATIONS	
Administration Expenses	290
Dividends Paid	2,429
Others	310
TOTAL APPLICATIONS	3,029
Internal Cash Generation Available for Investment	4,136

SOURCES AND APPLICATIONS OF FUNDS: POWER COMPANIES

1971-75

SOURCES	In million Cr$
Sales of Power	33,875
Other	854
TOTAL SOURCES	34,729
APPLICATIONS	
Generation, Transmission, Distribution and Administration	10,357
Reversion Fund and Interest	4,219
Taxes	473
Dividends to ELETROBRAS	1,933
Dividends to Public	3,382
Amortization and Interest	5,200
Other	2,241
TOTAL APPLICATIONS	25,564
Internal Cash Generation Available for Investment	6,924

SOURCES AND APPLICATIONS OF FUNDS BY INSTITUTION

1971-75

SOURCES	In million Cr$	%
ELETROBRAS		
Compulsory Loan	4,482	11.6
Reversion	3,997	10.3
Internal Cash Generation	4,136	10.6
Reinvestment of Dividends - Federal Government	2,316	6.0
Sole Tax	1,932	5.0
Fiscal Incentives	61	0.2
TOTAL ELETROBRAS	16,924	43.7
State Governments and Municipalities		
Sole Tax - States	2,591	6.7
State Government Budgetary Contributions	2,463	6.3
Reinvestment of Dividends - State Governments	968	2.5
Sole Tax - Municipalities	272	0.7
TOTAL STATE GOVERNMENTS AND MUNICIPALITIES	6,294	16.2
Power Companies		
International Cash Generation	6,924	17.8
Loans in Foreign Currency	6,215	16.1
Federal Government Budgetary Contributions	417	1.1
Sales of Shares to the Public	478	1.2
Reversion	275	0.7
TOTAL POWER COMPANIES	14,309	36.9
Others	334	0.9
To Be Sought	940	2.4
TOTAL SOURCES	38,800	100.0
APPLICATIONS		
Investments	30,103	77.6
Amortization		
Foreign Currency	2,366	6.1
Compulsory Loan	890	2.3
National Development Banks and Agencies	783	2.0
TOTAL AMORTIZATION	4,039	10.4
Interest and Commitment Fees		
Foreign Currency	2,199	5.7
Compulsory Loan	866	2.2
National Development Banks and Agencies	366	0.9
TOTAL INTEREST AND COMMITMENT FEES	3,431	8.8
Increase in Working Capital	1,227	3.2
TOTAL APPLICATIONS	38,800	100.0

NET FLOW OF COMMITTED FOREIGN FUNDS: 1971-75

(In millions US$)

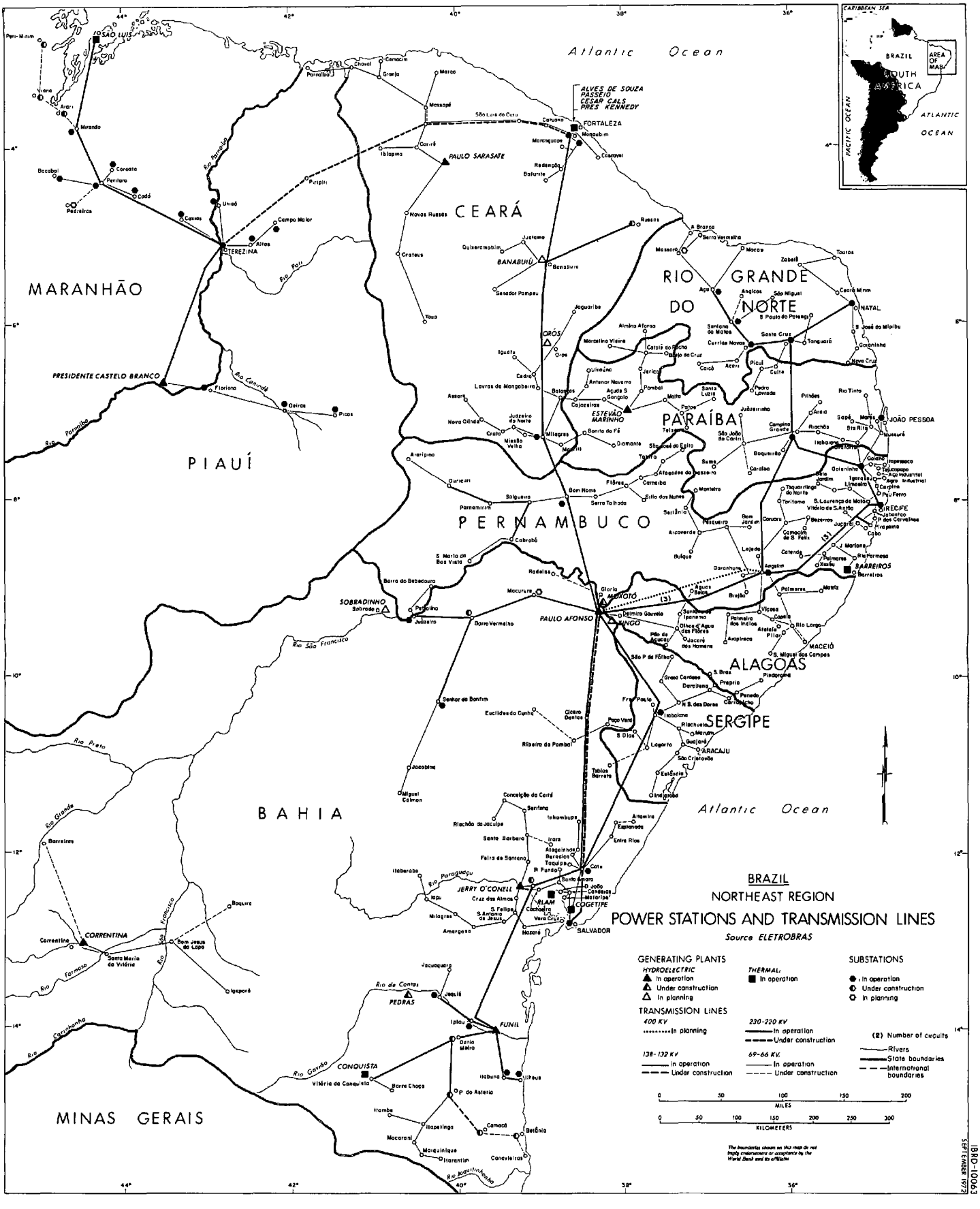
	1971	1972	1973	1974	1975	Total
IBRD						
Disbursements	93	63	44	37	29	286
Debt Service	30	43	49	46	50	218
Net Flow	63	40	-5	-9	-21	68
Interamerican Development Bank						
Disbursements	52	56	25	12	1	146
Debt Service	10	21	22	24	24	101
Net Flow	42	35	3	-12	-23	45
USAID						
Disbursements	30	33	6	6	-	75
Debt Service	13	14	15	19	22	83
Net Flow	17	19	-9	-13	-22	-8
EXIMBANK						
Disbursements	5	4	-	-	-	9
Debt Service	6	6	6	4	4	26
Net Flow	-1	-2	-6	-4	-4	-17
KWF						
Disbursements	7	17	2	1	-	27
Debt Service	2	2	3	5	5	17
Net Flow	5	15	-1	-4	-5	10
Others						
Disbursements	67	34	4	1	1	107
Debt Service	30	42	42	40	32	186
Net Flow	37	-8	-38	-39	-31	-79
Suppliers' Credit						
Disbursements	46	50	29	13	7	145
Debt Service	43	24	27	27	29	150
Net Flow	3	26	2	-14	-22	-5
American Foreign Power						
Disbursements	-	-	-	-	-	-
Debt Service	12	11	12	11	11	57
Net Flow	-12	-11	-12	-11	-11	-57
Total						
Disbursements	300	277	110	70	38	795
Debt Services	146	163	176	176	177	838
Net Flow	154	114	-66	-106	-139	-43
To Be Sought						
Disbursements	-	-	89	129	163	381
Debt Services	-	-	4	12	24	40
Net Flow	-	-	85	117	139	341
Grand Total						
Disbursements	300	277	199	199	201	1,176
Debt Service	146	163	180	188	201	878
Net Flow	154	114	19	11	-	298

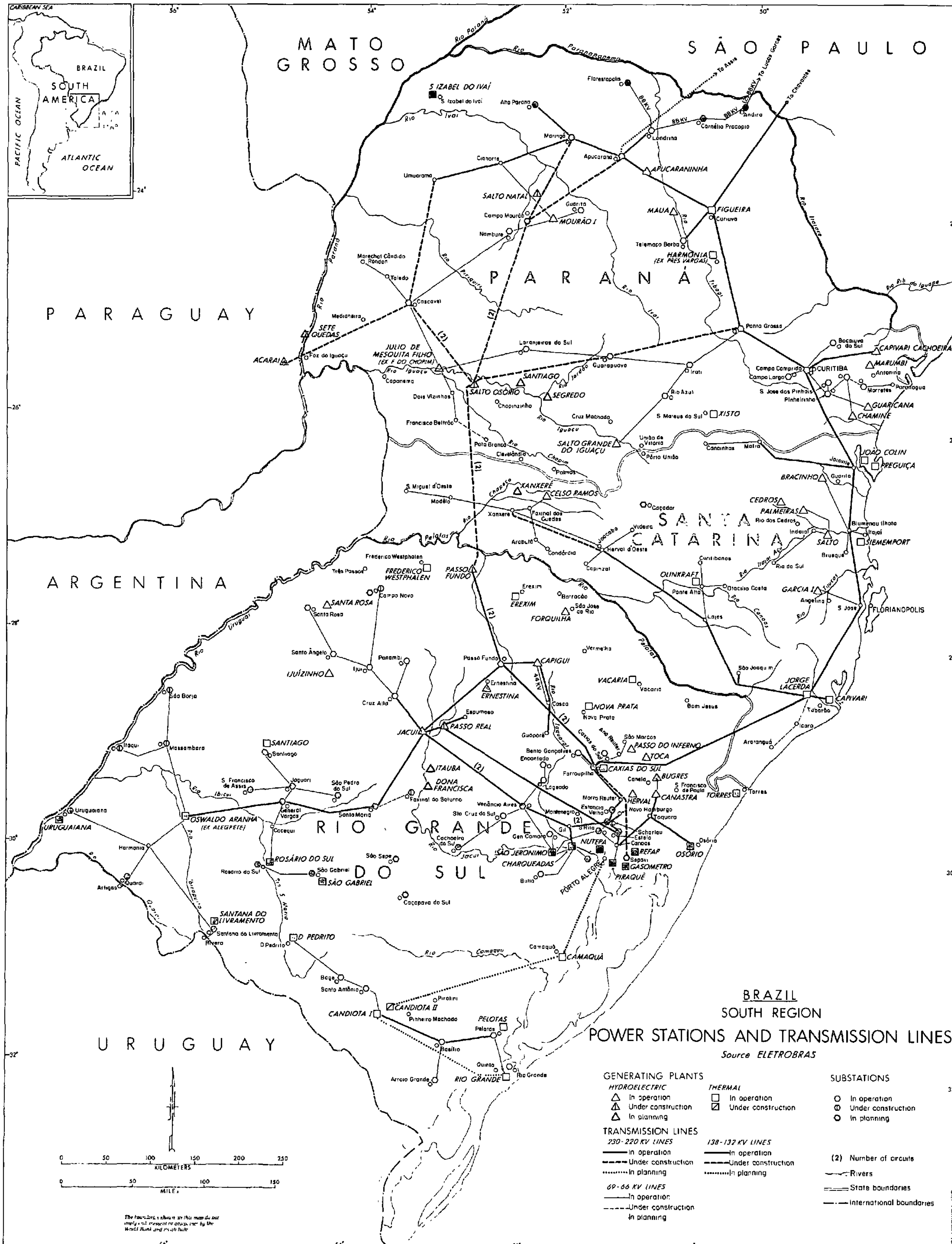
YEARLY LEGAL RETURN, DEPRECIATION, REVERSION, 1971-75

(As percentages of sector remunerable assets)

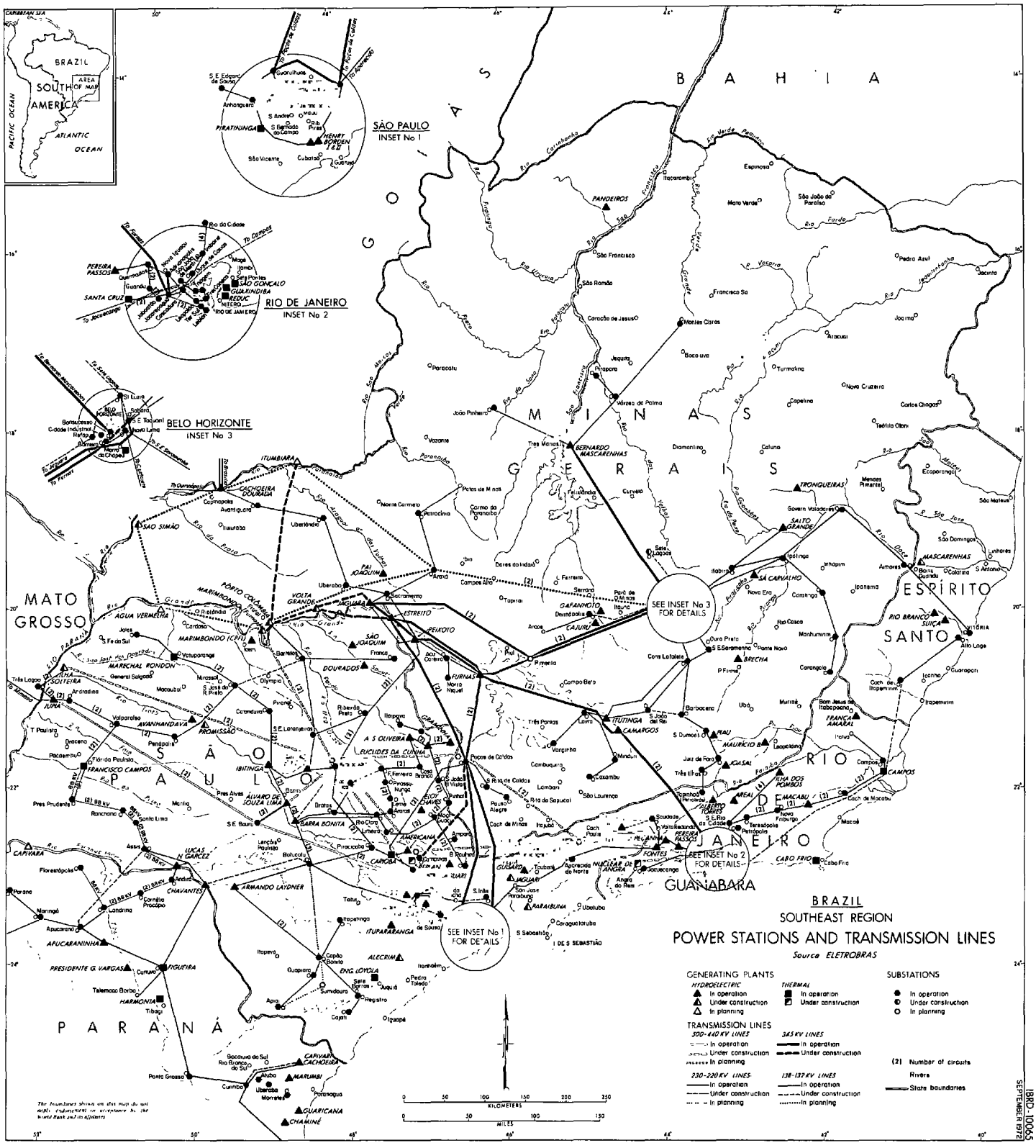
Item	1971	1972	1973	1974	1975	Average 1971-75
Legal Return	9.8%	11.0%	11.2%	11.1%	11.0%	10.9%
Depreciation	2.3%	2.4%	2.4%	2.4%	2.5%	2.4%
Reversion	1.6%	2.1%	2.8%	2.9%	2.9%	2.6%

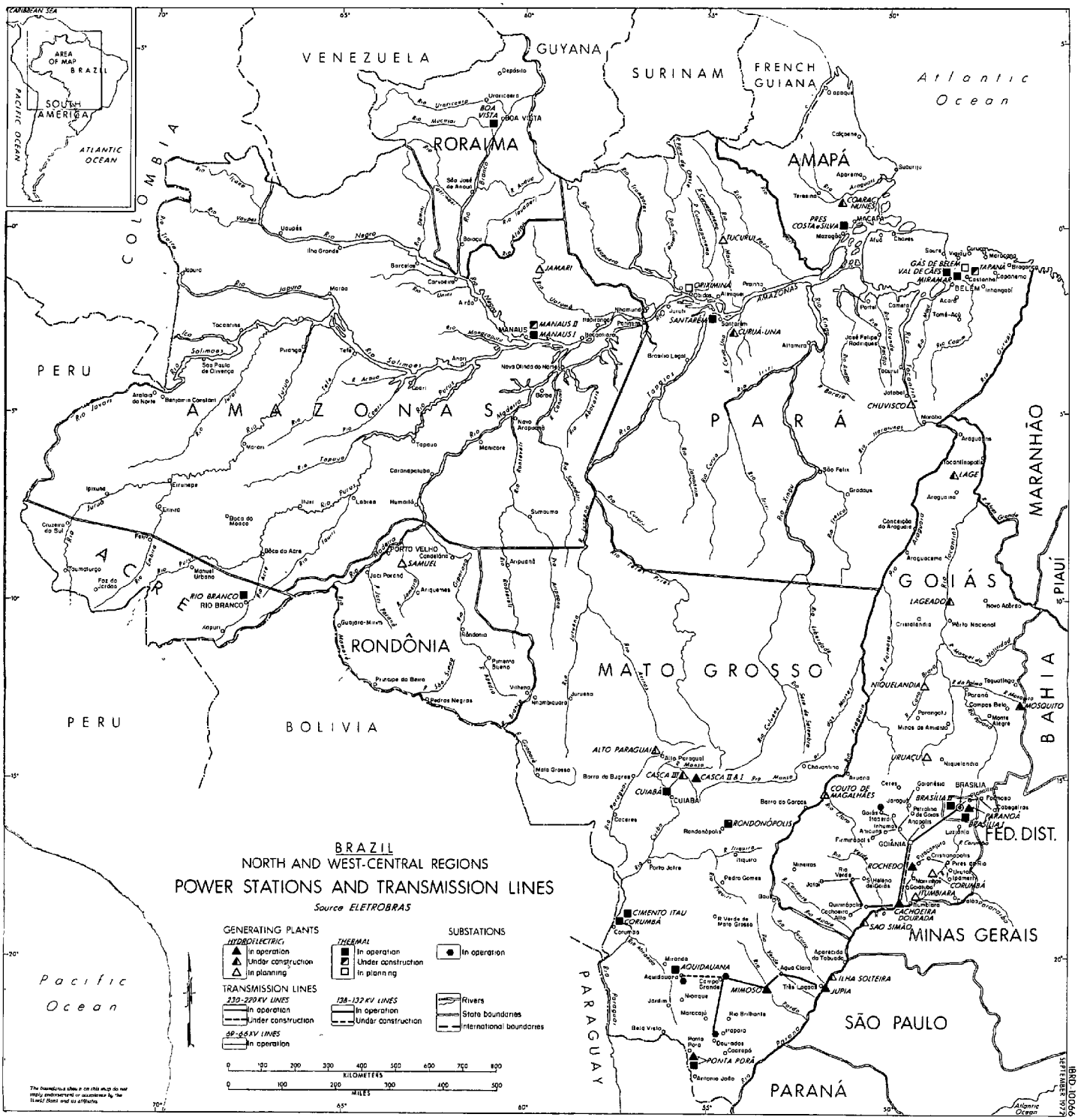
Source: ELETROBRAS/OPE 1971-75/revised.


Atlantic Ocean
CARIBBEAN SEA
BRAZIL
AREA OF MAP
SOUTH AMERICA
PACIFIC OCEAN
ATLANTIC OCEAN
ALVES DE SOUZA
PASSEIO
CESAR CALS
PRES KENNEDY
FORTALEZA
PAULO SARASATE
CEARÁ
MARANHÃO
PIAUÍ
PRESIDENTE CASTELO BRANCO
TEREZINA
BANABUIÚ
OROS
ESTEVÃO MARINHO
RIO GRANDE DO NORTE
NATAL
PARAÍBA
JOÃO PESSOA
PERNAMBUCO
RECIFE
BARREIROS
SOBRADINHO
PAULO AFONSO
MOXOTÓ
(3)
LUNGO
ALAGOAS
MACEIÓ
SERGIPE
ARACAJU
BAHIA
JERRY O'CONELL
CORRENTINA
PEDRAS
FUNIL
CONQUISTA
SALVADOR
MINAS GERAIS
BRAZIL
NORTHEAST REGION
POWER STATIONS AND TRANSMISSION LINES
Source ELETROBRAS
GENERATING PLANTS
HYDROELECTRIC
In operation
Under construction
In planning
THERMAL:
In operation
SUBSTATIONS
In operation
Under construction
In planning
TRANSMISSION LINES
400 KV
In planning
230-220 KV
In operation
Under construction
138-132 KV
In operation
Under construction
69-66 KV.
In operation
Under construction
(2) Number of circuits
Rivers
State boundaries
International boundaries
MILES
KILOMETERS
The boundaries shown on this map do not imply endorsement or acceptance by the World Bank and its affiliates
IBRD-10063
SEPTEMBER 1972



IBRD-10064
SEPTEMBER 1972


BRAZIL
SOUTH AMERICA
AREA OF MAP
CARIBBEAN SEA
PACIFIC OCEAN
ATLANTIC OCEAN
SÃO PAULO
INSET No 1
RIO DE JANEIRO
INSET No 2
BELO HORIZONTE
INSET No 3
SEE INSET No 3 FOR DETAILS
SEE INSET No 2 FOR DETAILS
SEE INSET No 1 FOR DETAILS
BRAZIL
SOUTHEAST REGION
POWER STATIONS AND TRANSMISSION LINES
Source ELETROBRAS
GENERATING PLANTS
HYDROELECTRIC
In operation
Under construction
In planning
THERMAL
In operation
Under construction
SUBSTATIONS
In operation
Under construction
In planning
TRANSMISSION LINES
500-440 KV LINES
In operation
Under construction
In planning
345 KV LINES
In operation
Under construction
230-220 KV LINES
In operation
Under construction
In planning
138-132 KV LINES
In operation
Under construction
In planning
(2) Number of circuits
Rivers
State boundaries
KILOMETERS
MILES
The boundaries shown on this map do not imply endorsement or acceptance by the World Bank and its affiliates
IBRD-10065
SEPTEMBER 1972


CARIBBEAN SEA
AREA OF MAP
BRAZIL
SOUTH AMERICA
PACIFIC OCEAN
ATLANTIC OCEAN
VENEZUELA
GUYANA
SURINAM
FRENCH GUIANA
Atlantic Ocean
COLOMBIA
RORAIMA
BOA VISTA
AMAPÁ
PERU
AMAZONAS
PARÁ
MARANHÃO
ACRE
RONDÔNIA
MATO GROSSO
GOIÁS
PIAUÍ
BAHIA
BOLIVIA
PARAGUAY
MINAS GERAIS
SÃO PAULO
PARANÁ
FED. DIST.
Pacific Ocean
MANAUS
SANTARÉM
BELÉM
BRASÍLIA
CUIABÁ
RIO BRANCO
PORTO VELHO
PONTA PORÃ
BRAZIL
NORTH AND WEST-CENTRAL REGIONS
POWER STATIONS AND TRANSMISSION LINES
Source ELETROBRAS
GENERATING PLANTS
HYDROELECTRIC
In operation
Under construction
In planning
THERMAL
In operation
Under construction
In planning
SUBSTATIONS
In operation
TRANSMISSION LINES
230-220 KV LINES
In operation
Under construction
138-132 KV LINES
In operation
Under construction
69-66 KV LINES
In operation
Rivers
State boundaries
International boundaries
KILOMETERS
MILES
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IBRD 10096
SEPTEMBER 1970